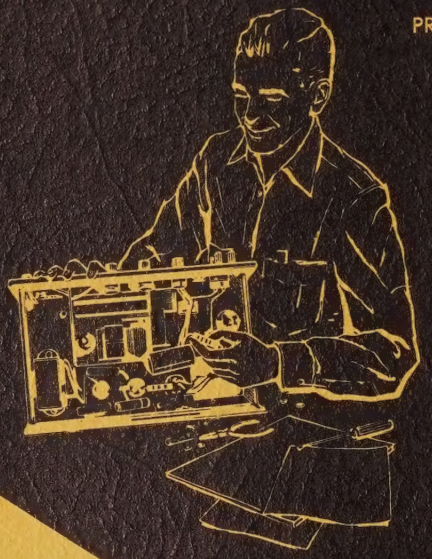
PRICE $3.00



Assembling
and Using Your...

# Heathkit

## TAPE RECORDER ELECTRONICS

MODEL TE-1A SERIES

HEATH COMPANY
*A Subsidiary of Daystrom Inc.*
BENTON HARBOR, MICHIGAN

595-286

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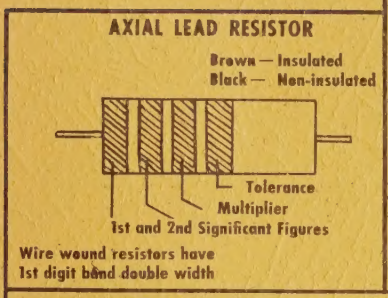
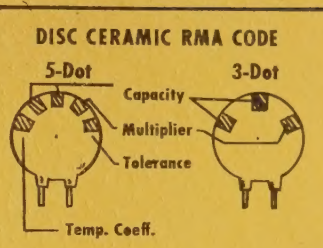
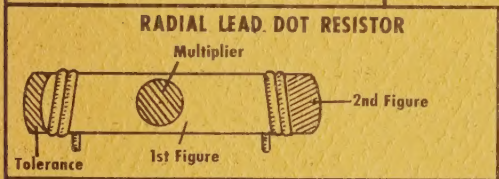
Heath Company

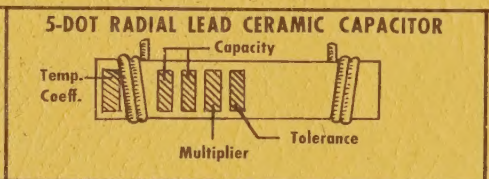
# STANDARD COLOR CODE — RESISTORS AND CAPACITORS

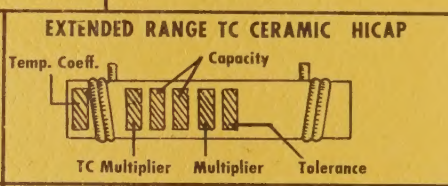


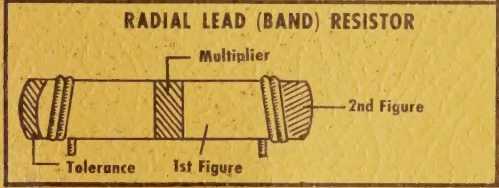

| INSULATED UNINSULATED Color | FIRST RING BODY COLOR First Figure | SECOND RING END COLOR Second Figure | THIRD RING DOT COLOR Multiplier |
|---|---|---|---|
| BLACK | 0 | 0 | None |
| BROWN | 1 | 1 | 0 |
| RED | 2 | 2 | 00 |
| ORANGE | 3 | 3 | ,000 |
| YELLOW | 4 | 4 | 0,000 |
| GREEN | 5 | 5 | 00,000 |
| BLUE | 6 | 6 | 000,000 |
| VIOLET | 7 | 7 | 0,000,000 |
| GRAY | 8 | 8 | 00,000,000 |
| WHITE | 9 | 9 | 000,000,000 |

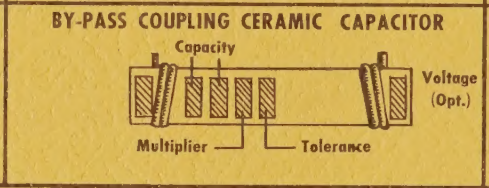


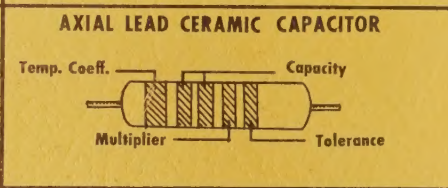



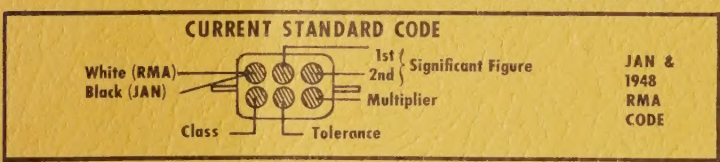



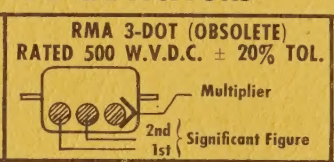



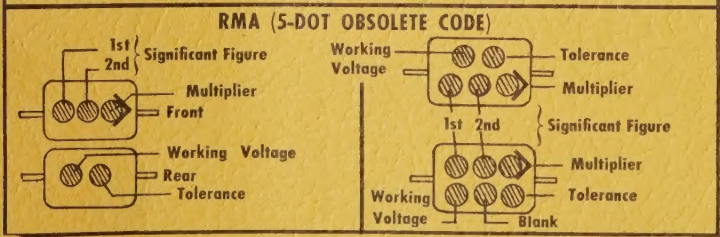

The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

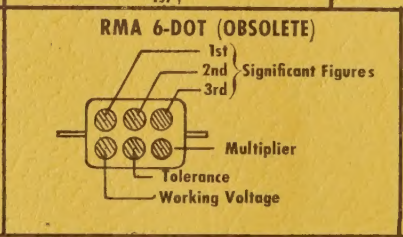
The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heathkits are ½ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors ½ watt, 1 or 2 watt may be color coded but the first band will be double width.

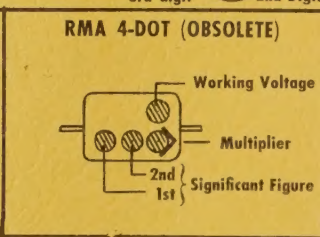
# MOLDED MICA TYPE CAPACITORS



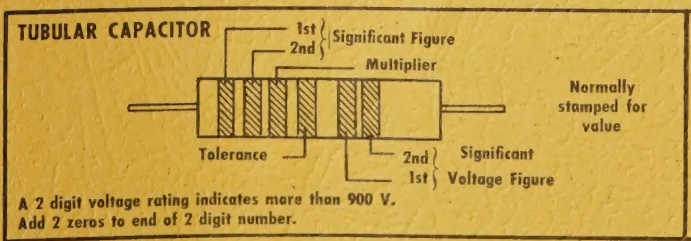



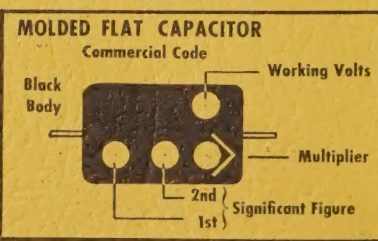


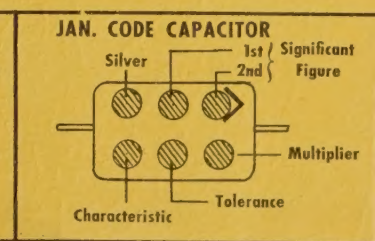




# MOLDED PAPER TYPE CAPACITORS




The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3 × 100 or 300 volts. Blue = 6 × 100 or 600 volts.

In the design of Heathkits, the temperature coefficient of ceramic or mica capacitors is not generally a critical factor and therefore Heathkit manuals avoid reference to temperature coefficient specifications.

Courtesy of Centralab

# ASSEMBLY AND OPERATION OF THE HEATHKIT TAPE RECORDER ELECTRONICS

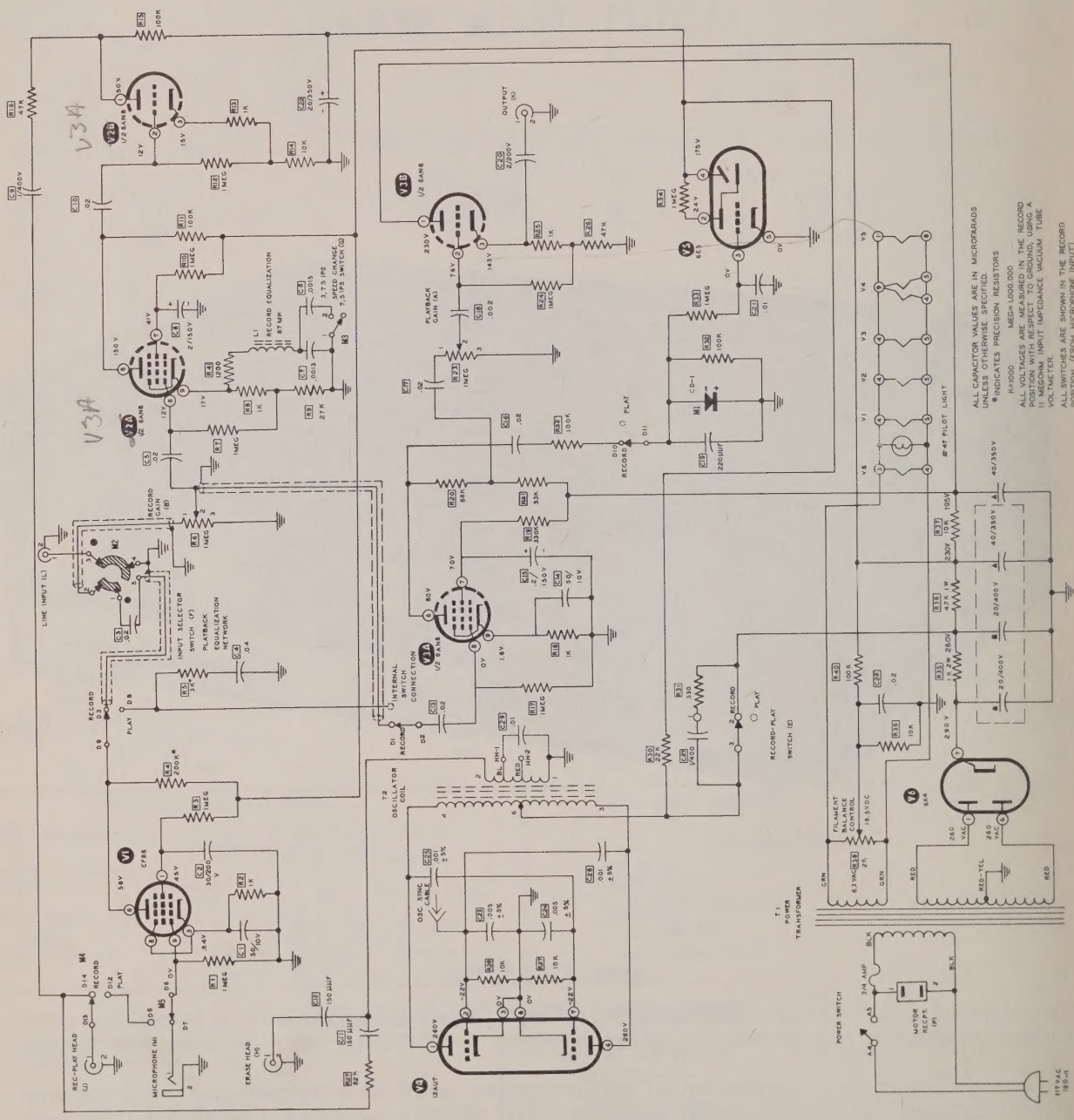
## MODEL TE-1A SERIES

### SPECIFICATIONS

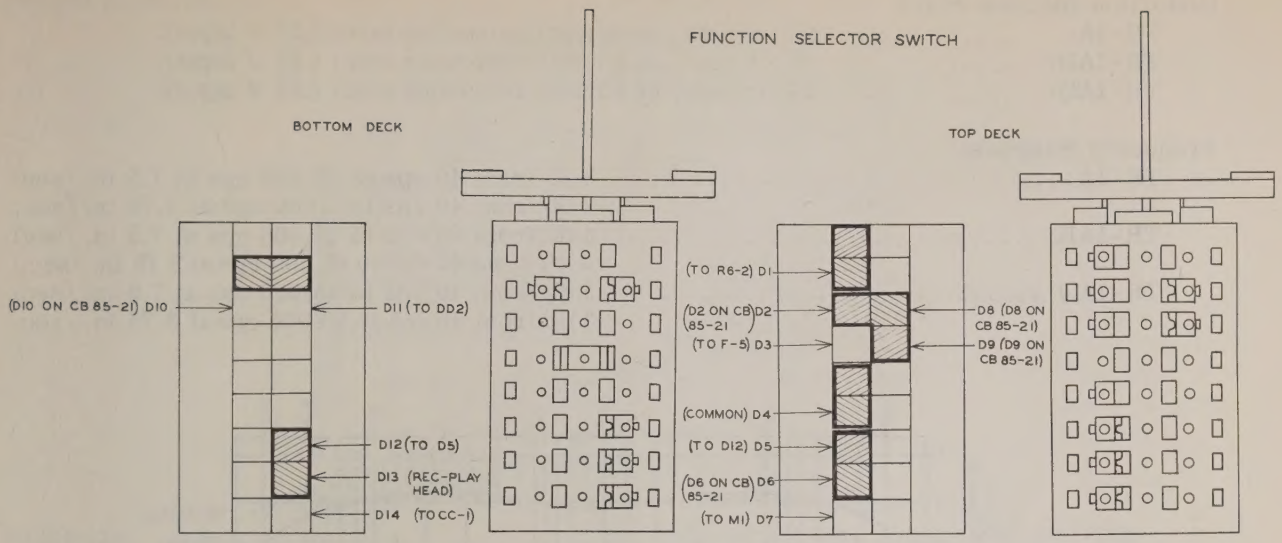
The following specifications are presented in the belief that you are entitled to a factual and comprehensive technical report on the performance of the Model TE-1A Tape Recorder Electronics.

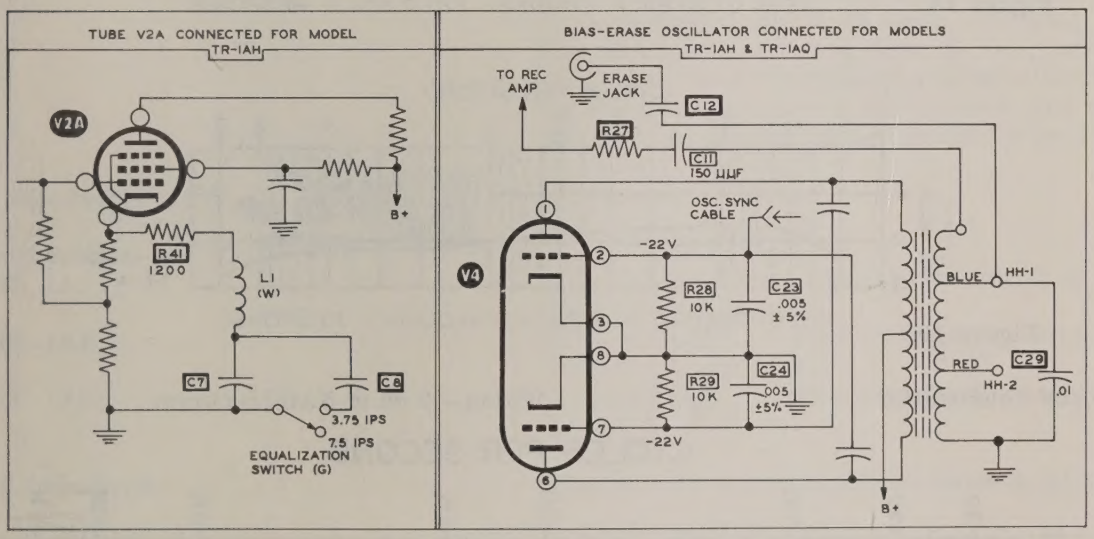
The specifications are based on actual measurements taken on a typical unit, using the most modern and accurate test equipment available today. Measurements were made under the most carefully controlled conditions to insure that the information presented is valid and in strict accordance with all generally accepted test conditions for tape recorders.

Minor variations from these specifications may be encountered in kit-assembled units. Such factors as exact lead placement, component variation, and tube characteristics are possible sources of deviations. Through the use of etched circuit boards and stable high quality components, these variables may be disregarded from a performance point of view.




SCHEMATIC
HEATHKIT TAPE RECORDER ELECTRONICS
Model TE-1A




| PART DESIGNATION | VALUE FOR TR-1A | VALUE FOR TR-1AH | VALUE FOR TR-1AQ | STAGE |
|---|---|---|---|---|
| R41 | 1200 Ω | 1200 Ω | 1200 Ω | V3A |
| C7 | .0013 µfd | .002 µfd | 910 µµf | Record Amp |
| C8 | .0015 µfd | .005 µfd | .002 µfd | |
| R27 | 82 KΩ | 68 KΩ | 180 KΩ | V4 Bias Erase Oscillator |
| C12 | 150 µµf | .003 µfd | .005 µfd | |

Signal to Noise Ratio:

TR-1A: ..... 45 db or better, referred to normal recording level (-10 dbm).
TR-1AH: ..... 45 db or better, referred to normal recording level (-10 dbm).
TR-1AQ: ..... 40 db or better, referred to normal recording level (-10 dbm).

Distortion (Record-Play):

| | | |
|---|---|---|
| TR-1A: | ..... | 2% or less, at normal recording level (.25 V input). |
| TR-1AH: | ..... | 2% or less, at normal recording level (.25 V input). |
| TR-1AQ: | ..... | 2% or less, at normal recording level (.25 V input). |

Frequency Response:

| | |
|---|---|
| TR-1A: ..... | ±3 db from 40 cps to 12,000 cps at 7.5 in./sec. |
| | ±3 db from 40 cps to 7,000 cps at 3.75 in./sec. |
| TR-1AH: ..... | ±3 db from 40 cps to 15,000 cps at 7.5 in./sec. |
| | ±3 db from 40 cps to 10,000 cps at 3.75 in./sec. |
| TR-1AQ: ..... | ±3 db from 40 cps to 15,000 cps at 7.5 in./sec. |
| | ±3 db from 40 cps to 10,000 cps at 3.75 in./sec. |

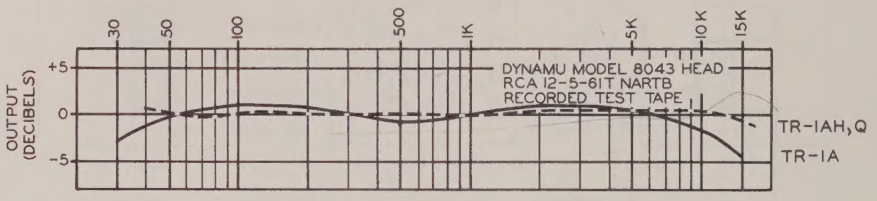



Figure 1A TE-1A PLAYBACK CHANNEL FREQUENCY RESPONSE

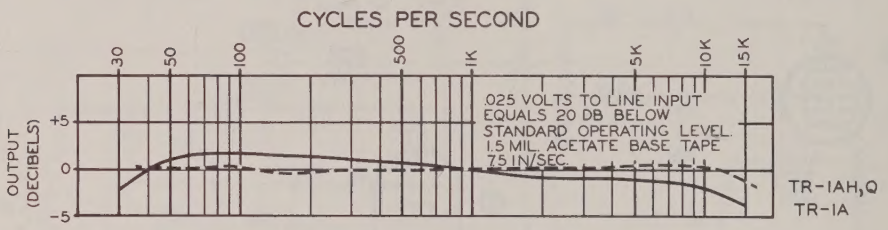
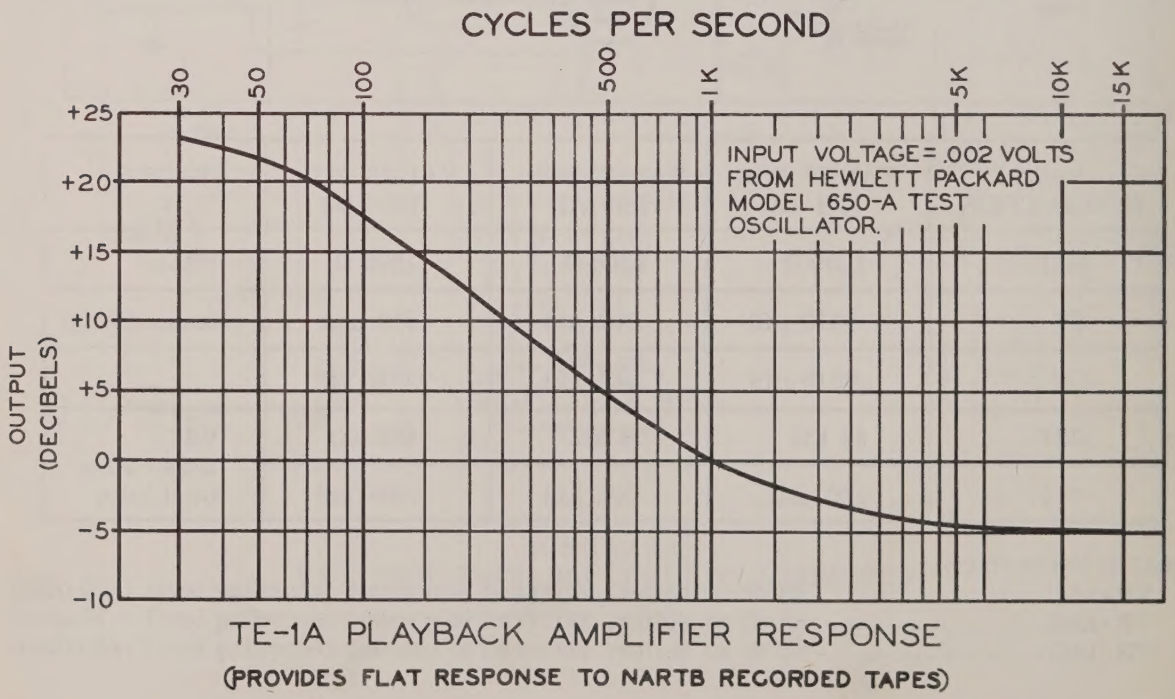



Figure 1B TE-1A RECORD-PLAYBACK FREQUENCY RESPONSE

Playback Equalization: ..... Within ± 2 db of NARTB curve.



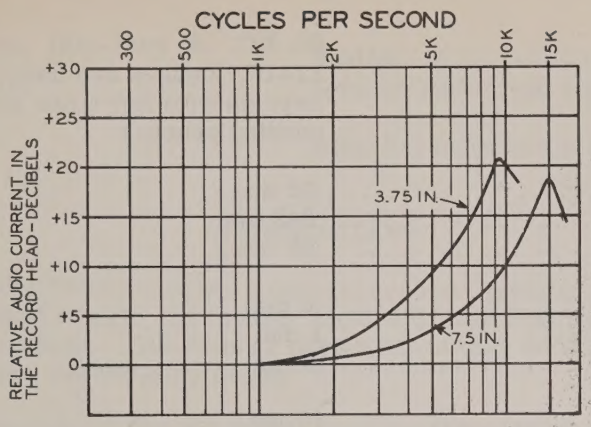

TE-1A PLAYBACK AMPLIFIER RESPONSE

(PROVIDES FLAT RESPONSE TO NARTB RECORDED TAPES)



Figure 2

Record Equalization: ..... See Figure 3.



TE-1A RECORD EQUALIZATION

Figure 3

Inputs (2): .....

1. Microphone (low level): 2.5 millivolts (-52 dbm) for high impedance dynamic, crystal and ceramic microphones.
2. Line (high level): 0.25 volts (-10 dbm). For off-the-air recording from T. V. or tuners, or records via direct connection to signal source. If a preamplifier control unit is used, this input should connect to the Tape Recorder Output Jack.

Input Impedance: ..... 1 megohm.

Output Level:

TR-1A: ..... Approximately 1.25 volts with the Playback Gain Control at maximum.

TR-1AH: ..... Approximately 1.0 volts with the Playback Gain Control at maximum.

TR-1AQ: ..... Approximately .75 volts with the Playback Gain Control at maximum.

Output Impedance: ..... Approximately 600 ohms from cathode follower.

Controls: ..... Separate Record and Playback Gain Controls are provided.

Switches (5): .....

1. AC Power (in conjunction with Playback Gain Control).
2. Input Selector (microphone or line input).
3. Equalization Selector (3.75 in./sec. or 7.5 in./sec.).
4. Record-Play Selector.
5. Record Interlock Push button is provided to prevent accidental erasure of recorded tape. This Interlock must be depressed before the Function Switch can be operated to the Record Position.

Record Level Indicator: ..... "Magic Eye" tube: Shadow just closes when approximately .25 volts is applied to the Line Input Jack with Record Gain at maximum; indicates relative recording level of signal applied to the Microphone Input Jack.

| | |
|---|---|
| Bias-Erase Frequency: | 60 KC. A push-pull oscillator, employing a 12AU7, insures symmetrical waveform which is important for low noise and distortion in the recording process. |
| Record (Audio) Current: | |
| TR-1A: | .06 ma. |
| TR-1AH: | .043 ma. |
| TR-1AQ: | .03 ma. |
| Bias Current: | |
| TR-1A: | .8 ma. |
| TR-1AH: | 1 ma. |
| TR-1AQ: | .3 ma. |
| Erase Current: | |
| TR-1A: | 13 ma. |
| TR-1AH: | 17 ma. |
| TR-1AQ: | 17 ma. |
| Input and Output Terminations: | Microphone - Standard Phone Jack.<br>All others - Standard Phono Jacks. |
| Tube Complement: | 1 - EF86 - Preamplifier.<br>2 - 6AN8 - Record and Playback Channels.<br>1 - 6E5 - "Magic Eye" Record Indicator.<br>1 - 12AU7 - Bias-Erase Oscillator.<br>1 - 6X4 - Rectifier. |
| Power Requirements: | 105-125 volts, 50-60 cycles, 20 watts. |
| Finish: | |
| Control Panel: | Black with gold lettering. Trim strip is aluminum anodized gold with brush finish. |
| Cabinet: | Vinyl-clad steel; has leather texture in black with inlaid gold design. |
| Dimensions: | |
| With Cabinet: | 4" high x 12 1/2" wide x 8" deep.<br>The depth dimension is from the front surface of the control panel excluding the knobs.<br>The height dimension is excluding the feet. |
| Mounting: | Requires a 3 1/2" x 12" mounting board cutout for front panel. (For portable use, see page 45).<br>Template included with kit. |
| Net Weight: | 8 lbs. |
| Shipping Weight: | 10 lbs. |

In accordance with good engineering practice, a list of test equipment used in making the specification measurements for the Heathkit Model TE-1A Tape Recorder Electronics is given below:

| | |
|---|---|
| Generators: | Hewlett-Packard Model 650A Test Oscillator.<br><br>Heathkit AG-9 Audio Generator (Inherent distortion less than .05%). |
| Distortion: | Hewlett-Packard Model 300A Harmonic Wave Analyzer.<br><br>Heathkit Model AV-3 Audio Voltmeter. |

Oscilloscope: ..... Heathkit Model OP-1 Professional Oscilloscope.
Line Voltage Control: ..... General Radio type W5MT Variac.

Arga Expanded Scale Line Voltage Meter.

## INTRODUCTION

The TE-1A Tape Recorder Electronics is a monaural record-playback preamplifier of relatively simple and straightforward design, but is fully capable of high fidelity performance in both record and playback applications. Full fidelity performance may be realized from any deck employing medium impedance record-play heads.

This unit is ideal for integration into a portable unit, or for custom mounting due to its small size and mechanical arrangement. This design was accomplished with these applications in mind.

## CIRUIT DESCRIPTION

As previously stated, the TE-1A Tape Recorder Electronics is of relatively basic design, but the very fact that the circuit is reflexed adds to the complexity of the unit. This complexity warrants a very thorough explanation of both the switching arrangement involved in changing the unit from record operation to playback, and a technical description of the circuit functions.

An understanding of the electronics will be more easily realized by the person who has had little or no previous experience with magnetic tape recording, if first, he allows himself to be guided through the block diagram which is shown below. Thus he will become acquainted with the basic purpose of each circuit and how it is related performance-wise to the associated circuits; after this is accomplished, a technical explanation of each stage can be more easily understood.

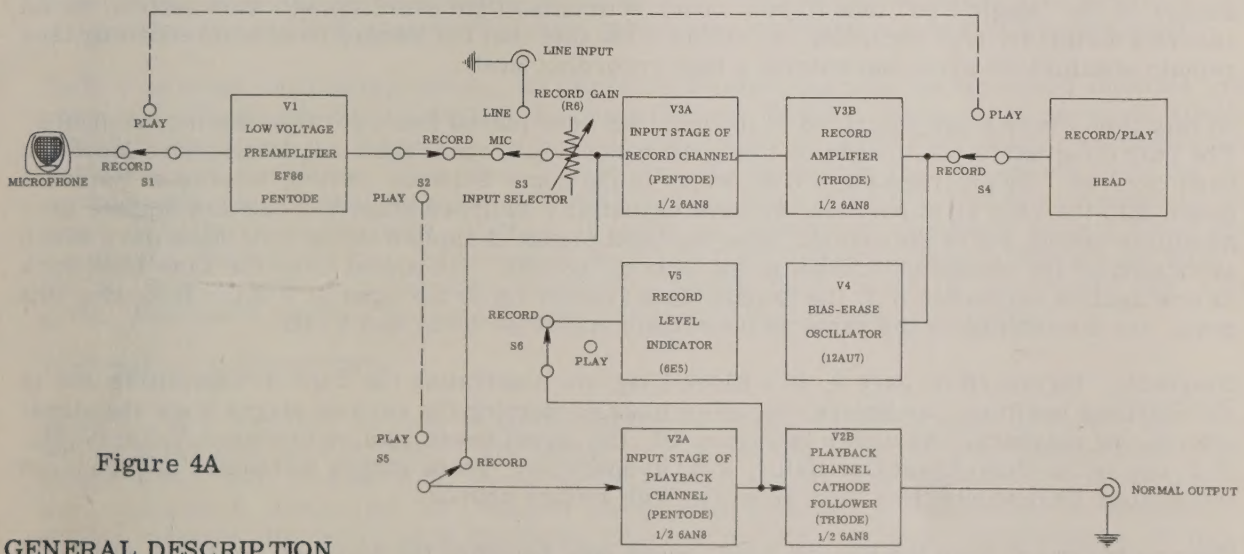



Figure 4A

## GENERAL DESCRIPTION

Record. Following the solid lines of Figure 4A, which show the signal path for the record position, let us first consider the audio signal to be recorded applied to the Microphone Input Jack. From the microphone, the signal is applied to stage V-1 through switch S-1. After amplification to an adequate level, the signal can be traced through switch S-2 to the Microphone Input (Mic. Input) position of the Input Selector Switch S-3. From switch S-3, the signal is then applied across the Record Gain Control at the input of stage V-3A. At this point the signal path divides so that a portion of the signal is then applied to the input of V-3A, is amplified and is then sent on to stage V-3B.

The signal at the output of V-3B is then applied to the Record-Play Head through switch S-4. More will be said of this recording process during the technical discussion which is to follow this general outline of the record and playback channels.

This completes the general description of the record channel except for the oscillator stage V-4, the output of which is applied along with the audio signal to the record head. An explanation of this circuit, and its two purposes, will be reserved for the latter part of the technical discussion, when the general record-playback functions have been described.

As was previously stated, the signal path divides at the input of V-3A and the second path may be traced down through switch S-5 to the input of stage V-2A.

During recording, this is the first stage of the record-monitor channel. At the output of V-2A, the signal path once again divides and the signal is applied both to V-2B and through switch S-6 to stage V-5, which is the Record Level Indicator ("Magic Eye" tube). From stage V-2B, the signal is applied to the phono-jack labeled "Normal Output" and subtitled "Record Monitor".

The signal applied to the record monitor channel (V-2A, V-2B) is not the signal recorded on the tape itself, but is, instead, the output from the low voltage preamplifier stage V-1. Thus, a very important point to keep in mind during future recording sessions is that the signal you are listening to while recording is not the signal applied to the tape, but is actually the signal applied to the input of the record channel. This fact is important because the quality of the recording is not apparent until the tape is played back. This is because you are monitoring, not the output of the record channel, but rather, the recording signal voltage after it has been amplified by stage V-1 to the proper level required for the input of V-3A. This is the first stage in the record channel.

A good quality, high-fidelity recording will be obtained if the Record Gain Control on the front panel is adjusted so that the highest peaks in the program material being recorded cause the shadow of the "Magic Eye" tube to just close, with only slight overlapping. This setting should assure a distortion-free recording, by virtue of the fact that the Record Head and recording tape remain unsaturated while maintaining a high recording level.

At this time every stage contained in the unit has been placed into operation during recording. The only thing left to point out is that only the recording process from the Microphone Input has been covered. By placing switch S-3, which is the Input Selector Switch, located on the front panel, into the Line Input position, we have essentially switched stage V-1 (the low voltage pre-amplifier stage), out of the circuit. Now the input signal is applied to the Line Input Jack which is located on the connector bracket at the rear of the unit. The signal from the Line Input Jack is now applied via switch S-3, the Record Gain Control R6 to the input of V-3A. Following this point, the description is the same as previously stated for V-3A and V-3B.

Playback. Figure 4B on page 9, is a Block Diagram illustrating the Tape Preamplifier unit in the playback position. As before, the solid lines connecting the various stages show the signal path during playback. As shown in Figure 4B, the signal is not applied to stages V-3A, V-3B, V-5, nor is the Bias-Erase Oscillator, V-4, in operation. These stages mentioned are rendered inoperative by disconnecting them from the high voltage source.

Tracing backward from the Record Head, which now becomes the playback head, the signal off the tape induces a voltage into the winding of the playback head, which is applied through switch S-4 and switch S-1 to stage V-1. The output of this stage then travels through switch S-2 and switch S-5 to the input of V-2A which is the playback channel (V-1 must be considered a low voltage preamplifier external to the playback amplifier).

Here lies the reason for the statement that the TE-1A is a reflexed unit; V-1 is a preamplifier for both record and playback channels. Signals which are taken directly off the tape are approximately the same amplitude as the voltage output of a good quality dynamic or crystal microphone.

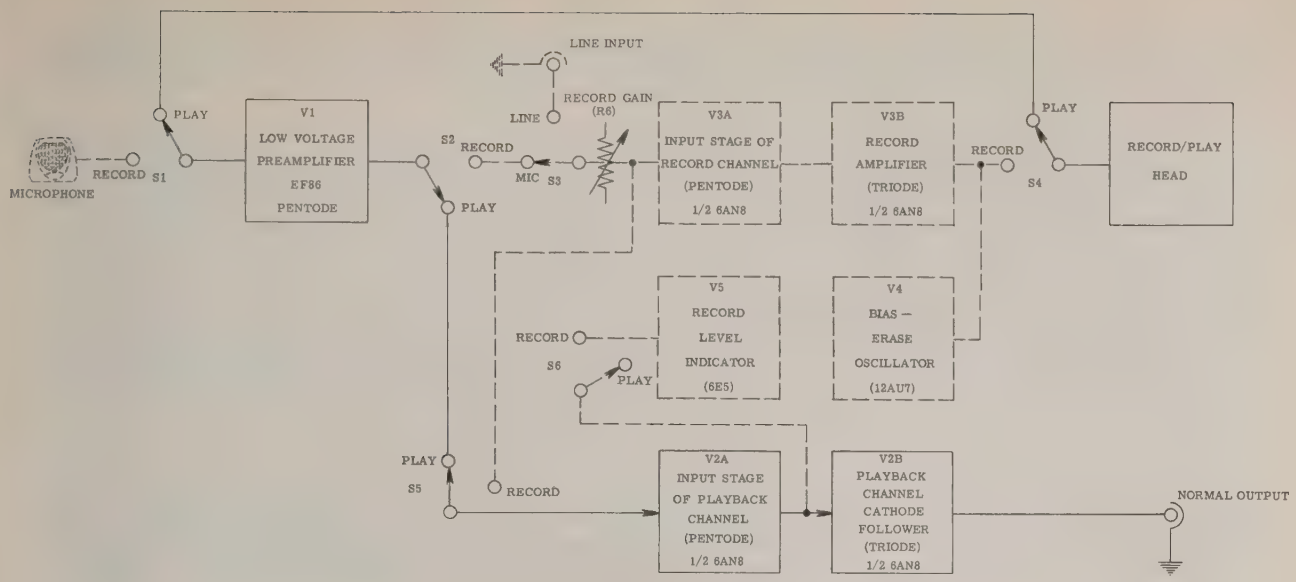



Figure 4B

The output of V-2A is now fed only to V-2B, since both the signal path to V-5 is open, (Switch S-6 is in the play position) and the plate voltage to V-5 is not applied. The output of V-2B is applied directly to the Output Jack.

At this point it is hoped that a person with little or no technical knowledge, aided by the use of the Block Diagrams, has been thoroughly acquainted with the basic purpose of each stage and its association with all other stages for both recording and playing back. Such an understanding is helpful towards efficient operation of this unit, in order to consistently obtain good quality, high fidelity recordings without making costly errors. A little care will avoid accidental erasure of a portion of a favorite prerecorded tape, which may represent a substantial investment.

To help prevent such an occurence, an interlock feature has been incorporated into this unit whereby the Interlock Button must be depressed before the lever knob can be operated into the RECORD position; i.e., the unit is normally locked into the PLAYBACK position, which disables the bias-erase oscillator. This does not eliminate the possibility that the person doing the recording will place the unit into the RECORD position while actually intending to playback the program material on the tape. Rather, it is the only practical safeguard to help avoid this possibility, since it is a two step procedure to go into RECORD as opposed to only one for PLAYBACK. A good point to remember, relating to playing back, is that if the "Magic Eye" tube glows, you are in trouble, because you are not playing back---you are erasing!

## TECHNICAL DESCRIPTION

Record. Now it is time to refer to the Schematic on Page 2 and once again to Figure 4A. The unit is in the RECORD position. The signal is now coming from the Microphone Input Jack. Switches S-1, S-2, S-4 and S-6, shown on the Block Diagram, now become various sections of the same switch, designated "D", but are electrically isolated from each other by segmented, sliding contacts. By referring to the Switch Diagram and its electrical representation (both are included on the Schematic), it is easy to see, for instance, that switch S-1 shown on the Block Diagram of Figure 4A is actually the contacts designated D-5, D-6, and D-7. Similarly, switch S-2 is actually D-3, D-8, and D-9. To further emphasize the earlier statement that the switch designations on the Block Diagram are in no way related to the switch designations shown on the Schematic, S-3 of Figure 4A is actually S-1 on the schematic, while S-3 on the Schematic is the ac power switch shown in the primary circuit of the power supply. This is not done to confuse the issue, but is intended to further simplify the technical description of the circuits, while tracking them on the Schematic.

It is helpful to keep in mind the Block Diagram for both the RECORD and PLAYBACK positions, while at the same time becoming familiar with the new switch designations. This will greatly simplify the task of understanding the electronics.

The signal from the Microphone Input Jack is applied through switch D (6-7) to the grid of stage V-1 This stage employs a high gain, low noise EF86 pentode. This tube is ideally suited for operation as a low noise, high gain microphone preamplifier stage. Low distortion is realized through the use of this tube despite the fact that the gain of the stage is 150 (45 db). Thus, for a microphone with output rated at approximately -55 dbm, the signal voltage output of this stage during recording is the same level that the Line Input is rated at (.25 V). The result of this is that if a steady tone for testing is applied to the Microphone Input Jack at the -55 dbm level, and the same signal applied to the Line Input Jack at a .25 V level, the Input Selector Switch could be switched to first one position then the other position, and upon playing back, there would be no difference in audio output level. This is noteworthy because the record level indication of the "Magic Eye" tube remains valid for recording in the microphone position.

The signal from V-1 passes on through switch D (9-3), C3, through the Input Selector Switch F to the top of R6, the Record Gain Control. The coupling capacitor C3 is used only for DC blocking, so that the plate voltage of V-1 is not applied across the Record Gain Control. At the sliding contact of the Record Gain Control, the signal path divides (keep in mind Figure 4A). We will continue through the record channel, then come back to the input of this channel later and pick up the second signal path.

The signal proceeds through C5 to the grid of V-3A, which is the pentode section of a 6AN8 triode-pentode. C5 is also used for dc blocking, since the grid resistor R7 is not grounded but returned to a dc voltage point between the cathode and ground (making it a cathode degenerative type amplifier). The degeneration developed across the 27 K ohm feedback resistor R9 is responsible for the low distortion in this stage.

The amplified signal at the plate of V-3A is coupled to the control grid of V-3B, which is the triode portion of tube V-3, the final record amplifier. The output of V-3B is developed across R15, its 100 K ohm plate load resistor.

The signal then proceeds through R16, C9, through switch D (14-13) to the Record-Play Head Connector. This applies the audio output signal of the record channel across the Record Head.

C9 is a blocking capacitor which prevents DC current from passing through the Record Head. If this were allowed to happen, the Head would be seriously and perhaps permanently magnetized. This would result in a very high distortion and noise level.

The impedance of the average record head at 1,000 cycles is rated at approximately 2,000 ohms, but increases with frequency since the head is an inductive device. Pre-emphasis of the high frequencies is required in the record channel in order to overcome losses in playing back (refer to Figure 2, the playback channel response curve), and also for losses due to the characteristics of the recording tape itself. This is accomplished by the series resonant circuit of L1 and C7, which is connected from the cathode, pin 9, to ground of stage V-3A. This network drastically lowers the cathode impedance of this stage as it approaches resonance at 15 kc (thus, the rising gain characteristic of V-3A as shown in Figure 3, the record equalization curve). The L1/C7 ratio has been chosen so that the rate of treble boost complements, as close as possible, the high frequency losses, which results in an essentially flat frequency response.

The switch on the front control panel labeled EQUALIZATION places C8 in parallel with C7, when recording at 3.75 in./sec. tape speed, which lowers the frequency of equalization for optimum response at this speed.

The bias erase oscillator stage, tube V-4, is a highly efficient push-pull oscillator designed to provide a 60 KC wave form of very low distortion. The output is capacitively coupled through C11 and R27 to the record head. The impedance of the C11, R27 network adjusts for the proper

amount of 60 KC bias current required in the record head. Note: These values are fixed to provide the proper amount of bias current for any deck employing the TR-1A Series head types.

At this point the audio signal becomes super-imposed on the 60 KC bias voltage, which is of such magnitude that the audio variations are biased to occur over the most linear portion of the tape's transfer characteristic. Without such biasing, extreme distortion would be produced in the recording process. The value of resistor R27 has been carefully selected to allow the proper amount of bias current that yields the lowest distortion.

As you will recall from Figure 4A, whenever the unit is placed into the record position, the bias-erase oscillator is automatically placed into operation. Thus, the oscillator is capacitively coupled through C12 to the erase head. The current induced into the erase head provides approximately 60 db of erasure, with average heads.

Playback. The recording process has been very thoroughly described, and now the unit in the play position can be discussed. The record head now becomes the playback head, so that the signal off the tape is coupled through switch contacts D13 to D12, and through D5 to D6 which is directly coupled to the control grid of V-1. The amplified signal is then equalized at the output of V-1 by the playback equalization network, C4 and R5, which is directly connected to the EF86 (V-1) plate, through Switch D (contacts 8 and 9).

To illustrate the effect of this network, consider a 500 cycle signal with an amplitude of 2.5 mv at the input of V-1. The output of V-1 is only 20 mv. The result is that the playback equalization network has reduced the gain of the low voltage preamplifier V-1 from a maximum of 150 at 40 cycles, down to 18 at 1000 cycles or by a factor of 25 db. This is verified by referring to Figure 2.

The output of V-1, after equalization, is coupled through switch D (1-2) and blocking capacitor C13, to the control grid of V-2A. The gain of V-2A is approximately 180, which produces a signal, at the plate of this stage, of approximately 4.5 volts. This is applied to the voltage divider, R20 and R21.

The signal which is coupled through blocking capacitor C17, the Playback Gain Control and blocking capacitor C18, to the grid of tube V-2B, is approximately 1.26 volts in amplitude. Tube V-2B is the cathode follower stage for the playback (record monitor) channel, and it has a gain of .96 which yields an output of approximately 1.25 volts.

The Record Level Indicator ("Magic Eye" tube) circuit receives its signal voltage from the top of the R20, R21 voltage divider at the plate of tube V-2A during recording only. As was stated earlier, the signal voltage at that point is approximately 4.5 volts. This, during recording, is applied through switch D (contacts 10 and 11) to the crystal diode. The signal is rectified by the crystal diode and filtered by C19 to produce a negative dc bias voltage which is further filtered by R33 and C21, then applied to the control grid of the "Magic Eye" tube.

The power supply employs a 6X4 tube, (V-6), operating as a full wave rectifier. A multisection R-C network filters the dc output of this tube from which all dc plate and screen grid voltages are supplied.

Filament power is derived from a 6.3 volt ac winding across which a balancing network has been connected to allow balancing the filament winding for minimum hum. Resistors R39 and R40 form a voltage divider by means of which a moderate positive potential is applied to the slider of the Balance Control. This serves to counteract any hum injection in the tubes due to heater-cathode emission.

This completes the technical description of the unit, with only one additional comment; an additional playback channel would be required to monitor the signal on the tape while recording, along with a separate playback head mounted on the tape deck.

## PRELIMINARY INSTRUCTIONS

This manual is supplied to assist you in every way to complete the instrument with the least possible chance for error. We suggest that you take a few minutes now and read the entire manual through before any work is started. This will enable you to proceed with the work much faster when construction is started. The large fold-in pictorials are handy to attach to the wall above your work space. Their use will greatly simplify the completion of the kit. These diagrams are repeated in smaller form within the manual. We suggest that you retain the manual in your files for future reference, both in the use of the instrument and for its maintenance.

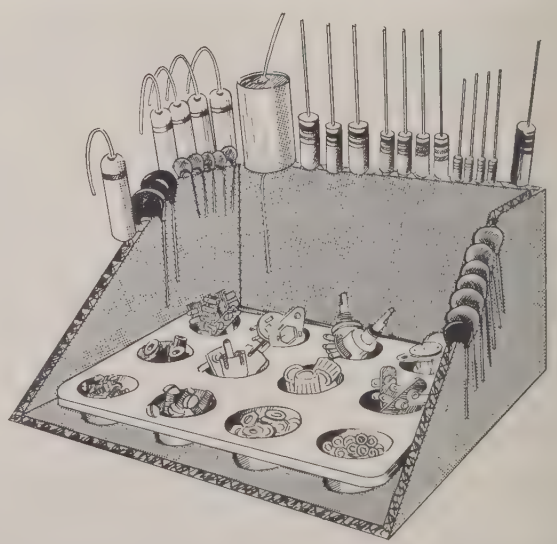
### UNPACKING INFORMATION

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the charts and other information shown on the inside covers of your manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the REPLACEMENT section and supply the information called for therein, and include all inspection slips in your letter to us. Hardware items are counted by weight and there may be a few more or less than the quantity specified. If a few are missing, please obtain them locally if at all possible.

Resistors and controls generally have a tolerance rating of ± 20% unless otherwise stated in the parts list. Therefore a 100 KΩ resistor may test anywhere from 80 KΩ to 120 KΩ. (The letter K is commonly used to designate a multiplier of 1000.) Tolerances on capacitors are generally even greater. Limits of +100% and -50% are common for electrolytic capacitors. The parts furnished with your Heathkit have been specified so as to not adversely affect the operation of the finished instrument.

In order to expedite delivery to you, we are occasionally forced to make minor substitutions of parts. Such substitutions are carefully checked before they are approved and the parts supplied will work satisfactorily. By checking the parts list for resistors, for example, you may find that a 120 KΩ resistor has been supplied in place of a 100 KΩ as shown in the parts list. These changes are self-evident and are mentioned here only to prevent confusion in checking the contents of your kit.

Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.



We suggest you do the following before any work is started:

1. Attach the large pictorials to the wall above your workbench.
2. Go through the entire assembly and wiring instructions. This is an excellent time to read the entire instruction section through and familiarize yourself with the procedure.
3. Lay out all parts so that they are readily available. Refer to the general information inside the front and back covers of this manual to help you identify components.

### NOTES ON WIRING

Read the notes on soldering and wiring on the inside rear cover. Crimp all leads tightly to the terminal before soldering. Be sure both the lead and terminal are free of wax, corrosion or

other foreign substances. Use only the best rosin core solder, preferably a type containing the new activated fluxes such as Kester "Resin-Five," Ersin "Multicore" or similar types.

Unless otherwise indicated, all wire used is insulated. Wherever there is a possibility of the bare leads on resistors and capacitors shorting to other parts or to chassis, the leads should be covered with insulated sleeving. This is normally indicated in the instructions by the phrase "use sleeving". Bare wire is used where the lead lengths are short and the possibility of short circuits are non-existent.

Leads on resistors, capacitors and transformers are generally much longer than they need to be to make the indicated connections. In these cases, the excess leads should be cut off before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points. Not only does this make the wiring much neater but in many instances, the excessively long leads will actually interfere with proper operation of the instrument.

The pictorials indicate actual chassis wiring and designate values of the component parts. We very strongly urge that the chassis layout, lead placement and grounding connections be followed exactly as shown. While the arrangement shown is probably not the only satisfactory layout, it is the result of considerable experimentation and trial. If followed carefully, it will result in a stable instrument operating at a high degree of accuracy and dependability.

Space has been provided for you to check off each operation as it is completed. This is particularly important in wiring and it may prevent omissions or errors, especially where your work is interrupted frequently as the wiring progresses. Some kit builders have also found it helpful to mark each lead in colored pencil on the pictorial as it is added.

The abbreviation "NS" indicates that the connection should not be soldered as yet, for other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number appears after each solder (S) instruction. This number indicates the number of leads connected to the terminal in question. For example, if the instructions read, "Connect a 33 K ohm resistor from socket V2-9 (S2) to terminal strip CC-3 (NS)", this indicates that two leads will be connected to lug 9 of socket V2 at the time it is soldered. This additional check will help avoid errors.

The following instructions are presented in a simple, logical, step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before you start to do it. When the step is completed, check it off in the space provided.

## Notes On Circuit Board Wiring.

Before attempting any work on the circuit boards, study Figure 5 on Page 14 and read the general instructions below carefully.

The following general rules are very simple and a few minutes spent in learning them will be an excellent investment. The growing application of circuit boards to all electronic equipment will soon require all technicians to be familiar with these practices.

1. NEVER USE SO-CALLED "NON-CORROSIVE" PASTES OR OTHER FLUXES. The copper foil on the circuit board has been specifically processed for ease in soldering. It will take solder perfectly, provided radio-grade rosin-core solder is used. Very little solder is required to make a perfect connection. Try to prevent flow of flux onto the circuit board proper.

2. DO NOT OVERHEAT THE CONNECTION. A soldering pencil is ideal. If a soldering gun is used, be very careful to avoid excessive heating. Try to develop a technique to "solder it and get off".

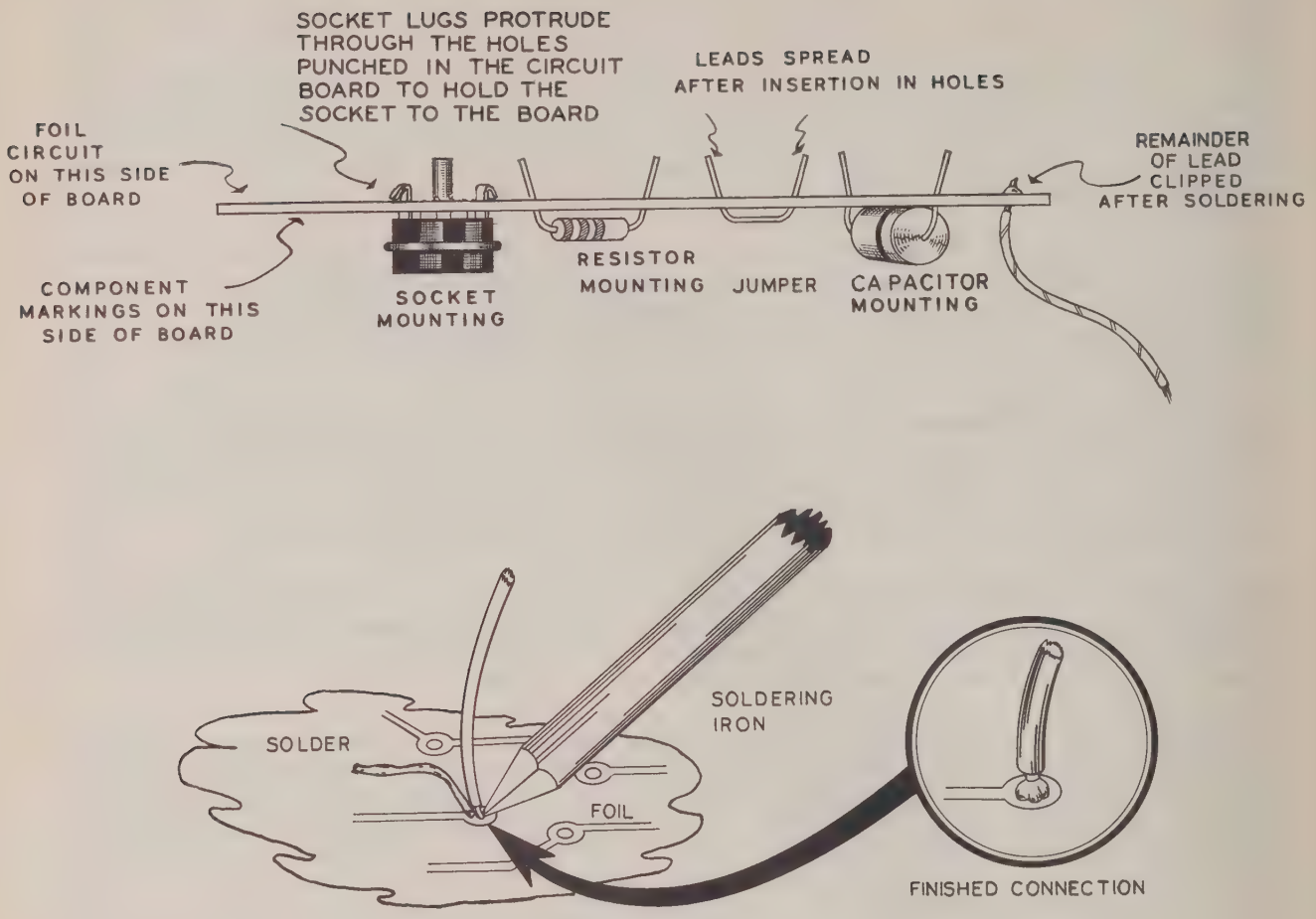

SOCKET LUGS PROTRUDE THROUGH THE HOLES PUNCHED IN THE CIRCUIT BOARD TO HOLD THE SOCKET TO THE BOARD
LEADS SPREAD AFTER INSERTION IN HOLES
FOIL CIRCUIT ON THIS SIDE OF BOARD
REMAINDER OF LEAD CLIPPED AFTER SOLDERING
COMPONENT MARKINGS ON THIS SIDE OF BOARD
SOCKET MOUNTING
RESISTOR MOUNTING
JUMPER
CAPACITOR MOUNTING
SOLDERING IRON
SOLDER
FOIL
FINISHED CONNECTION

Figure 5

3. Remember that components are generally placed on the phenolic side of the board, with their leads passing through holes to the foil side of the board. Bend the leads slightly to prevent parts from falling out as they are mounted. It is generally easier to mount most or all the parts in this way and then solder all the connections at one time.

4. The markings on the phenolic side of the board are there to assist you in wiring and to expedite your assembly. Follow the wiring sequence diagrams, Figure 6 and 7, so that no parts or jumpers are omitted.

## CIRCUIT BOARD COMPONENT MOUNTING

### PLAYBACK CIRCUIT BOARD

Identify the playback circuit board (#85-21), which is illustrated from the components side in Figure 6. Mount all components in the sequence shown in Figure 6, and check off each operation as it is completed. Special consideration should be given to the orientation of tube sockets; make sure that the tube sockets are installed with the shield clips positioned as shown. When all components have been mounted solder all connections on the foil side of the board, without filling the unused holes. Clip off all excess leads, then lay this aside where it will not be damaged.

( ) Identify the 9 pin shielded tube socket (with shield clip) and install at V1 on the screened side of playback circuit board 85-21. Be sure all the tube socket pins are aligned properly with the tube socket holes on the board. Then apply enough pressure to seat the body of the socket firmly against the board and the pins protrude through to the foil side. Solder the center post to the foil, then solder all ten contacts including the locator pin.

( ) Similarly, install a 9 pin shielded tube socket at V2 on circuit board 85-21.

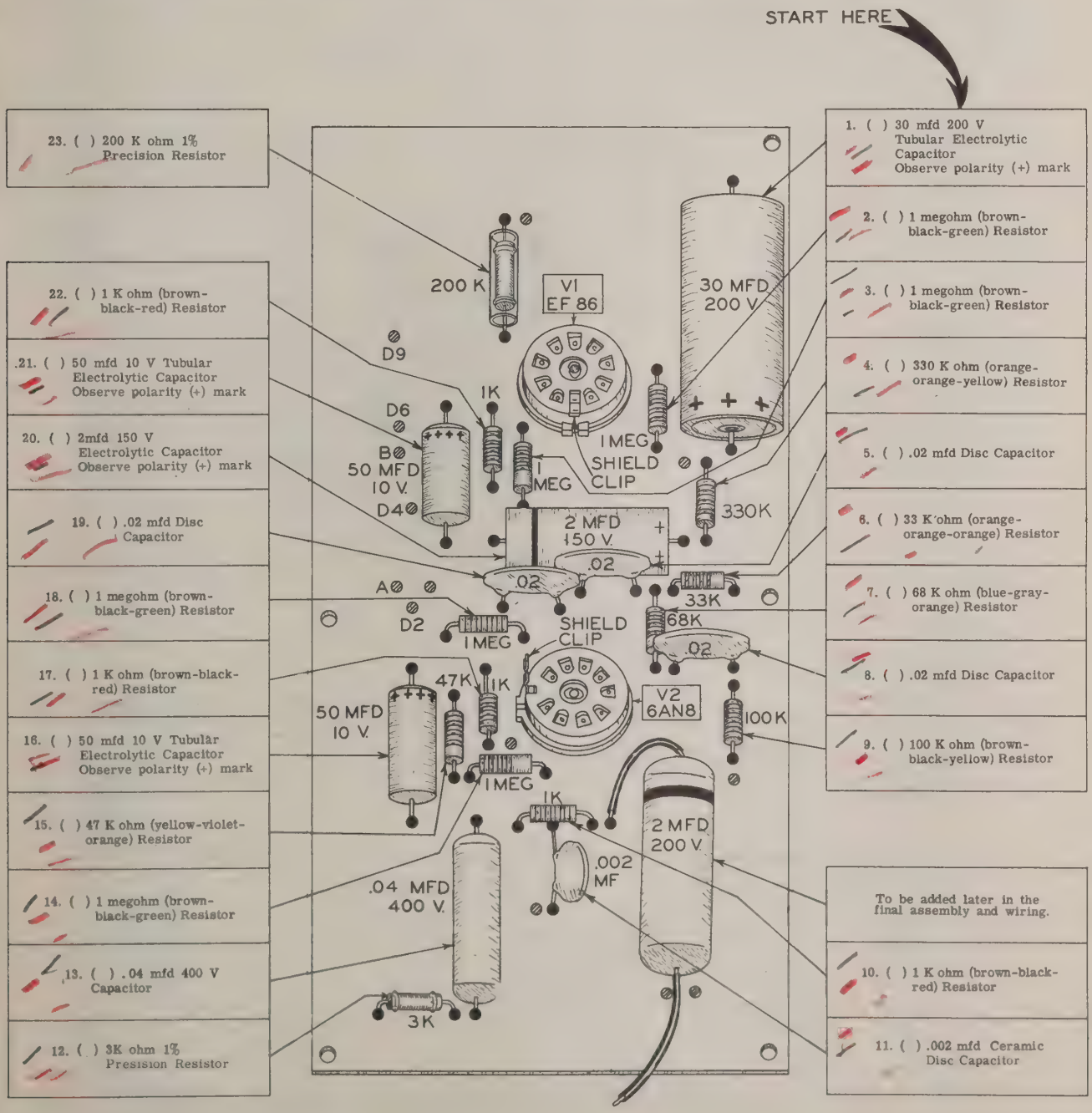

START HERE
23. ( ) 200 K ohm 1% Precision Resistor
22. ( ) 1 K ohm (brown-black-red) Resistor
21. ( ) 50 mfd 10 V Tubular Electrolytic Capacitor Observe polarity (+) mark
20. ( ) 2mfd 150 V Electrolytic Capacitor Observe polarity (+) mark
19. ( ) .02 mfd Disc Capacitor
18. ( ) 1 megohm (brown-black-green) Resistor
17. ( ) 1 K ohm (brown-black-red) Resistor
16. ( ) 50 mfd 10 V Tubular Electrolytic Capacitor Observe polarity (+) mark
15. ( ) 47 K ohm (yellow-violet-orange) Resistor
14. ( ) 1 megohm (brown-black-green) Resistor
13. ( ) .04 mfd 400 V Capacitor
12. ( ) 3K ohm 1% Presision Resistor
1. ( ) 30 mfd 200 V Tubular Electrolytic Capacitor Observe polarity (+) mark
2. ( ) 1 megohm (brown-black-green) Resistor
3. ( ) 1 megohm (brown-black-green) Resistor
4. ( ) 330 K ohm (orange-orange-yellow) Resistor
5. ( ) .02 mfd Disc Capacitor
6. ( ) 33 K ohm (orange-orange-orange) Resistor
7. ( ) 68 K ohm (blue-gray-orange) Resistor
8. ( ) .02 mfd Disc Capacitor
9. ( ) 100 K ohm (brown-black-yellow) Resistor
To be added later in the final assembly and wiring.
10. ( ) 1 K ohm (brown-black-red) Resistor
11. ( ) .002 mfd Ceramic Disc Capacitor
200 K
V1 EF 86
30 MFD 200 V
D9
1K
D6
B
50 MFD 10 V.
D4
1 MEG
1 MEG
SHIELD CLIP
330K
2 MFD 150 V.
.02
A
D2
1 MEG
33K
68K
SHIELD CLIP
.02
47K
1K
50 MFD 10 V.
V2 6AN8
100K
1 MEG
1K
2 MFD 200 V.
.002 MF
.04 MFD 400 V.
3K

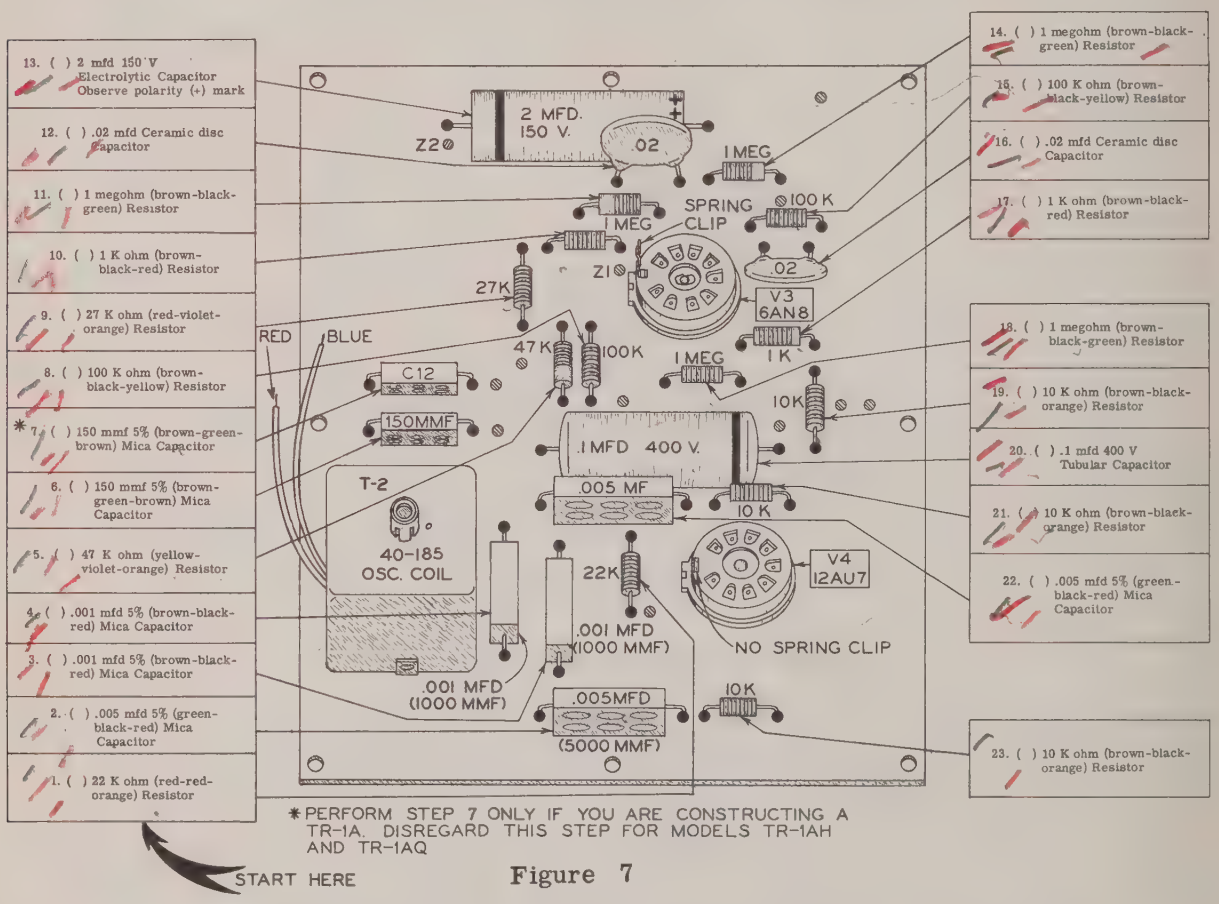
Figure 6

## RECORD CIRCUIT BOARD

The record circuit board (#85-22) is shown in Figure 7 from the component side of the board. Mount all components in the sequence shown in Figure 7 and orient them exactly as shown. Again, check off each operation as it is completed.

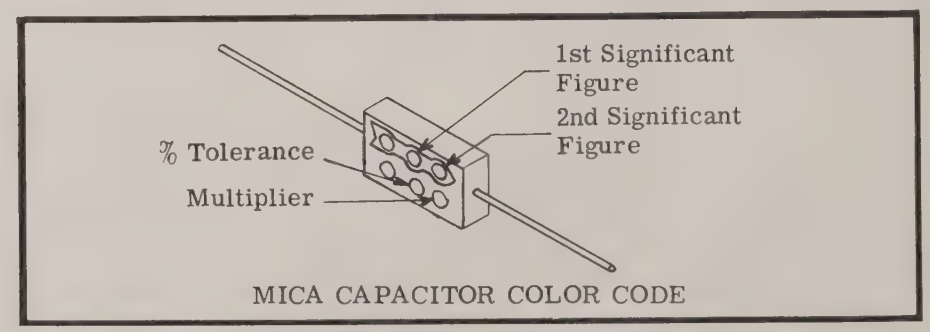
( ) Identify the 9 pin shielded tube socket (with shield clip) and install at V3 on the screened side of the record circuit board 85-22. Observe the precautions outlined previously and solder to secure to the foil.

( ) Install an unshielded 9 pin tube socket at V4. Solder all contacts to the foil.


13. ( ) 2 mfd 150 V Electrolytic Capacitor Observe polarity (+) mark
12. ( ) .02 mfd Ceramic disc Capacitor
11. ( ) 1 megohm (brown-black-green) Resistor
10. ( ) 1 K ohm (brown-black-red) Resistor
9. ( ) 27 K ohm (red-violet-orange) Resistor
8. ( ) 100 K ohm (brown-black-yellow) Resistor
*7. ( ) 150 mmf 5% (brown-green-brown) Mica Capacitor
6. ( ) 150 mmf 5% (brown-green-brown) Mica Capacitor
5. ( ) 47 K ohm (yellow-violet-orange) Resistor
4. ( ) .001 mfd 5% (brown-black-red) Mica Capacitor
3. ( ) .001 mfd 5% (brown-black-red) Mica Capacitor
2. ( ) .005 mfd 5% (green-black-red) Mica Capacitor
1. ( ) 22 K ohm (red-red-orange) Resistor
14. ( ) 1 megohm (brown-black-green) Resistor
15. ( ) 100 K ohm (brown-black-yellow) Resistor
16. ( ) .02 mfd Ceramic disc Capacitor
17. ( ) 1 K ohm (brown-black-red) Resistor
18. ( ) 1 megohm (brown-black-green) Resistor
19. ( ) 10 K ohm (brown-black-orange) Resistor
20. ( ) .1 mfd 400 V Tubular Capacitor
21. ( ) 10 K ohm (brown-black-orange) Resistor
22. ( ) .005 mfd 5% (green-black-red) Mica Capacitor
23. ( ) 10 K ohm (brown-black-orange) Resistor
2 MFD. 150 V.
.02
1 MEG
SPRING CLIP
100 K
Z2
Z1
27K
V3 6AN8
RED
BLUE
47 K
100K
1 MEG
1 K
C12
150MMF
10K
.1 MFD 400 V.
.005 MF
T-2
40-185 OSC. COIL
10 K
22K
V4 12AU7
.001 MFD (1000 MMF)
NO SPRING CLIP
.001 MFD (1000 MMF)
.005MFD (5000 MMF)
10K
START HERE

*PERFORM STEP 7 ONLY IF YOU ARE CONSTRUCTING A TR-1A. DISREGARD THIS STEP FOR MODELS TR-1AH AND TR-1AQ

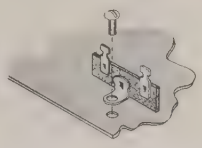
Figure 7




( ) After all components are mounted, solder each connection; then clip off all excess leads.

( ) Install the #40-185 oscillator coil on the component side of the board, at location T-2. When seated firmly with the five lugs projecting through the slots in the board, secure with two #4 lockwashers and 4-40 x 1/4" nuts. CAUTION: Do not overtighten. Carefully solder the five coil lugs so they make definite contact with the foil.

( ) Temporarily install the miniature 2-lug terminal strip at HH. Secure with 3-48 hardware. Refer to the accompanying illustrations for locating hole HH.



Detail 1

( ) Cut the blue oscillator lead to the proper length to reach HH-1. Remove 5/16" of insulation and connect to HH-1 (NS).

( ) Cut the red oscillator lead to the proper length to reach HH-2. Remove 5/16" of insulation and connect to HH-2 (NS).

( ) Trim the leads of a .01 μfd disc ceramic capacitor to 1/2" in length and connect from HH-1 (NS) to the hole in the terminal strip mounting tab (S1).

NOTE: THREE ALTERNATE METHODS OF CONNECTING THE OSCILLATOR SECONDARY LEADS ARE GIVEN BELOW. DETERMINE WHICH APPLIES TO YOUR CASE, AND THEN IGNORE THE OTHER TWO.

OSCILLATOR SECONDARY CONNECTION FOR TR-1A MONAURAL RECORDER, or any head array requiring up to 15 ma (maximum) erase current.

( ) Solder HH-1 (S2) and HH-2 (S1). Refer to Figure 8.

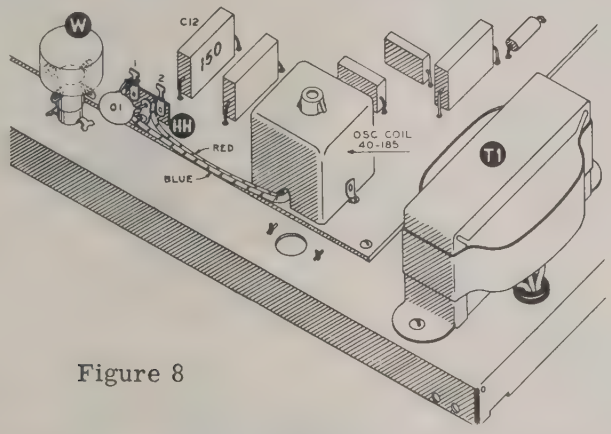



Figure 8

OSCILLATOR SECONDARY CONNECTIONS FOR THE TR-1AH AND TR-1AQ KITS

For any other head array requiring from 17 ma to 100 ma erase current, adjust the value of C12 until the manufacturer's recommended erase current is obtained. Refer to Figure 9.

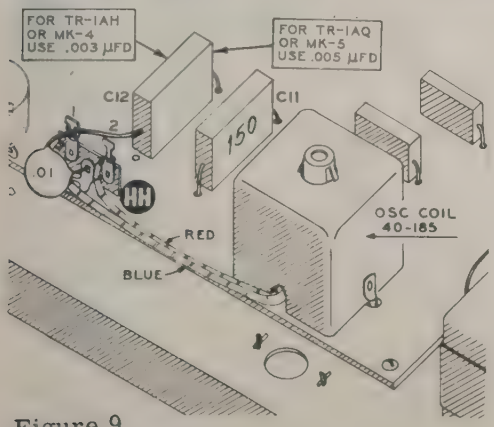



Figure 9

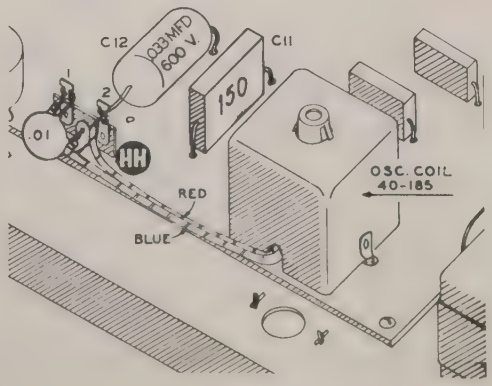



Figure 10

(D63-181)
(C63-183)
(E63-182)
(10-86)
(19-27)
SWITCH "D"
1/8" SPACER
BRACKET "Z"
6-32X3/4"
3/8" SPACER
CHASSIS

PICTORIAL 1

Only one of the next two steps need be performed; use the applicable one only.

( ) IF YOU HAVE A TR-1AH, install a .003 mfd (orange-black-red) capacitor in place of C12, from HH-1 (S3) to circuit board #85-22 (S1).
( ) IF YOU HAVE A TR-1AQ, install a .005 mfd (green-black-red) capacitor in place of C12, from HH-1 (S3) to circuit board #85-22 (S1).
( ) Solder HH-2 (S1).

OSCILLATOR SECONDARY CONNECTION FOR ERASE CURRENT REQUIREMENTS FROM 150 MA TO 300 MA.

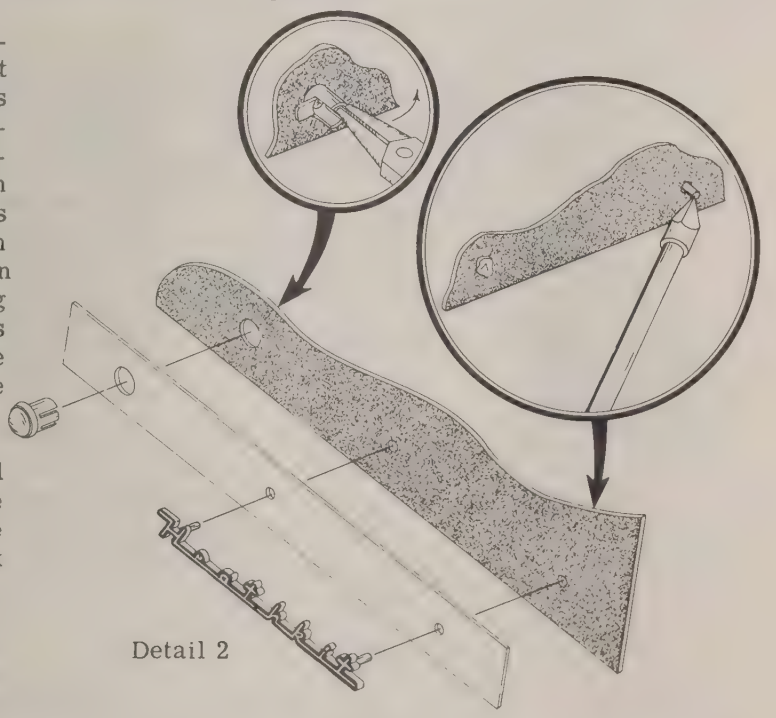
( ) Install a .033 mfd 600 V tubular capacitor in place of C12, from HH-2 (S2) to circuit board #85-22 (S1). Refer to Figure 10 on page 17.
( ) Solder HH-1 (S1).

## STEP-BY-STEP ASSEMBLY INSTRUCTIONS

IMPORTANT: In mounting parts to the chassis, use lockwashers under all nuts unless otherwise specified.

Generally refer to Pictorials 1 and 2 for visual information pertaining to this section; in addition, supplementary information will be specified in some steps.

( ) Place the aluminum gold anodized trim strip on the front dress panel and align the holes in the trim strip with the corresponding holes of the dress panel. Place the Heath nameplate in position with the proper holes and press firmly to the trim strip. Touch a hot soldering iron to the plastic studs extending through to the back of the dress panel and melt them down to the panel. This will secure the nameplate.



Detail 2

( ) Install the pilot light jewel through the hole in the opposite end of the trim strip. Bend the narrow segments of the shank over to hold it firmly in place.

( ) Position the dress panel against the control mounting panel on the chassis, so that the holes properly align. Then mount Control A (19-27). Position the terminals as shown. Use a control nut, flat washer, and lockwasher as shown in Figure 11 on Page 20. Do not tighten the control nut at this time; it will remain loose until all controls have been mounted so that the front dress panel may be properly aligned.
( ) In a similar manner, mount Control B (10-86), the Record Gain Control.
( ) Mount the Input Selector Switch F (D63-181). Orient the switch as shown.
( ) Install the Equalization Switch G (C63-183). Orient as shown.
( ) Identify the connector mounting bracket, by referring to Detail 3 on Page 21, and mount at the location indicated. Use 6-32 hardware. (Mount the screws from the top of the chassis.)
( ) Install 3/8" rubber grommets in holes R, S, U, V, and AC.
( ) Install a double phono jack at HJ. Use 6-32 hardware through the four mounting holes. (See Detail 3.) Be sure to include the insulators.
( ) Similarly, install another double phono jack at KL.
( ) Mount the phone jack at M.

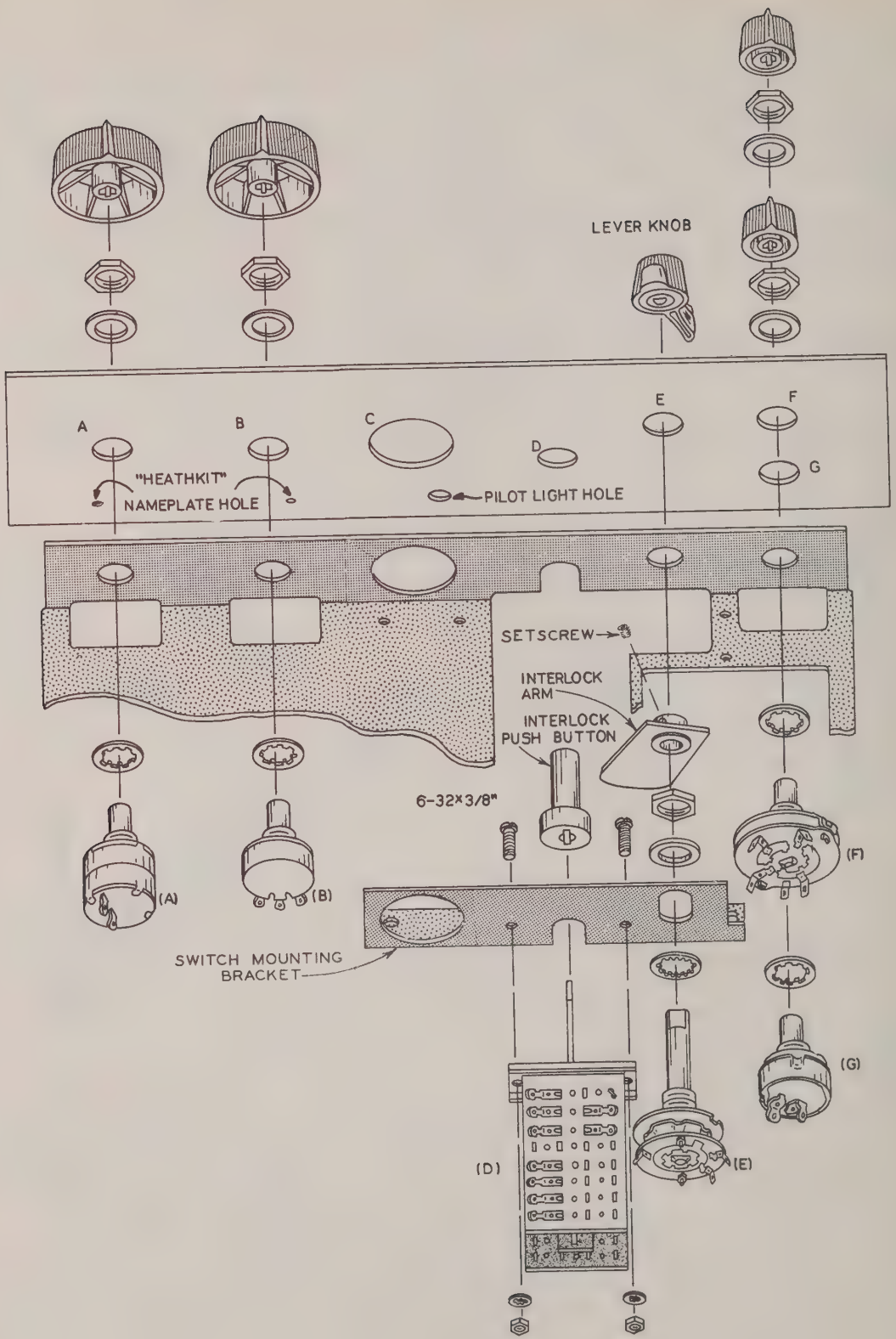
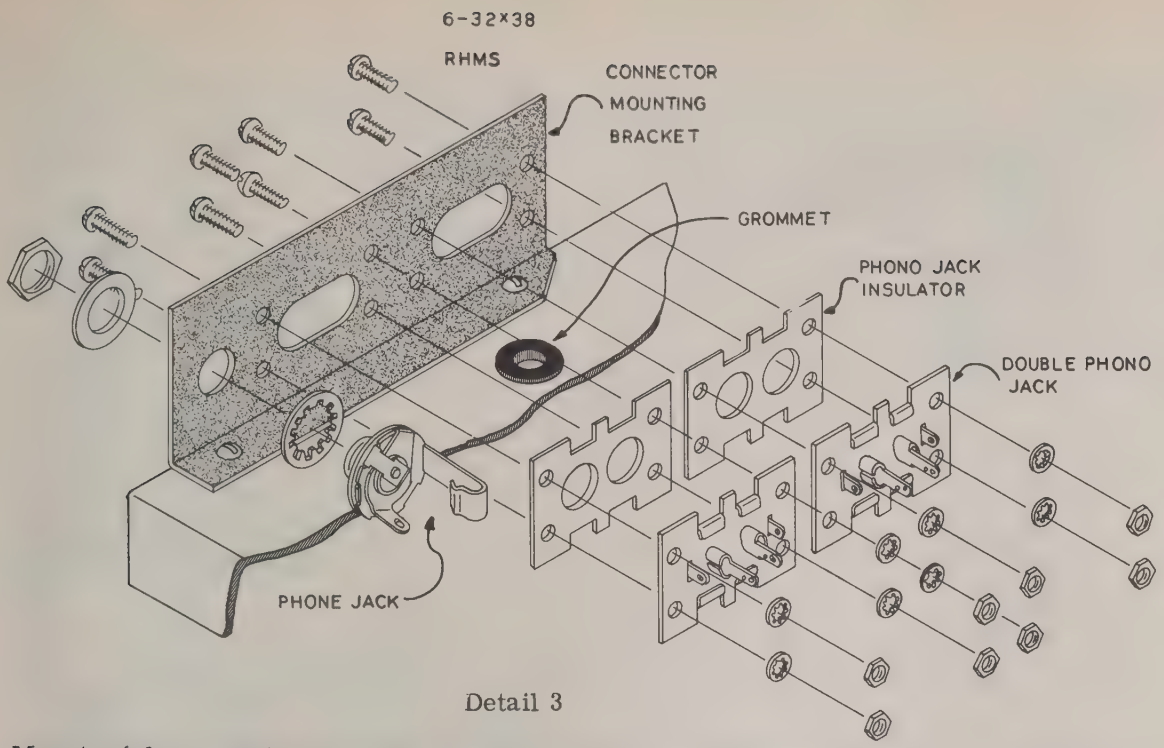

LEVER KNOB
A
B
C
D
E
F
G
"HEATHKIT" NAMEPLATE HOLE
PILOT LIGHT HOLE
SETSCREW
INTERLOCK ARM
INTERLOCK PUSH BUTTON
6-32×3/8"
(A)
(B)
(F)
(G)
(D)
(E)
SWITCH MOUNTING BRACKET

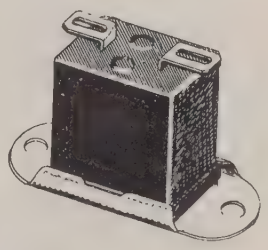
Figure 11




Detail 3

( ) Mount a 4-lug capacitor mounting wafer at O with 6-32 hardware. Be sure to include a 1-lug terminal strip under the proper lockwasher as shown. All electrolytic capacitor mounting wafers should be mounted on top of the chassis. See Pictorial 2.

( ) Mount a 3-lug capacitor mounting wafer at Q. Position it as shown.

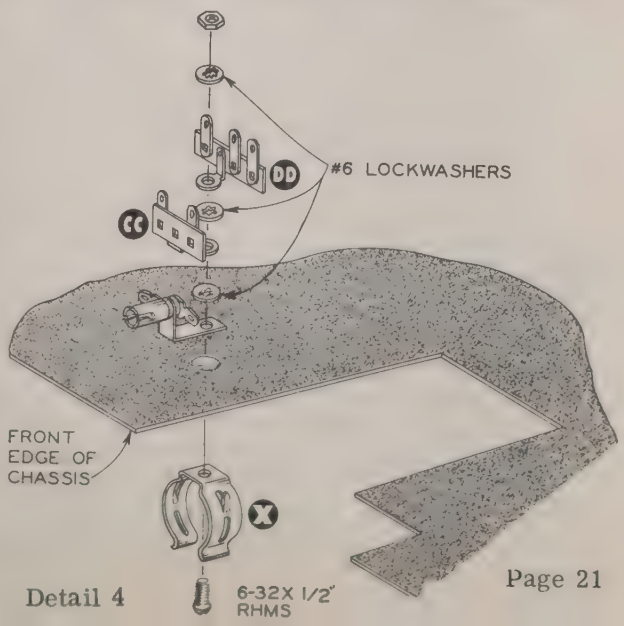


( ) Locate the 117 volt power socket and bend the lugs exactly as shown in the accompanying detail. Be sure that the #6 x 3/8" spacers are included as shown in Pictorial 1 on Page 18. Use 6-32 x 3/4" screws, #6 lockwashers and 6-32 x 1/4" hex nuts.

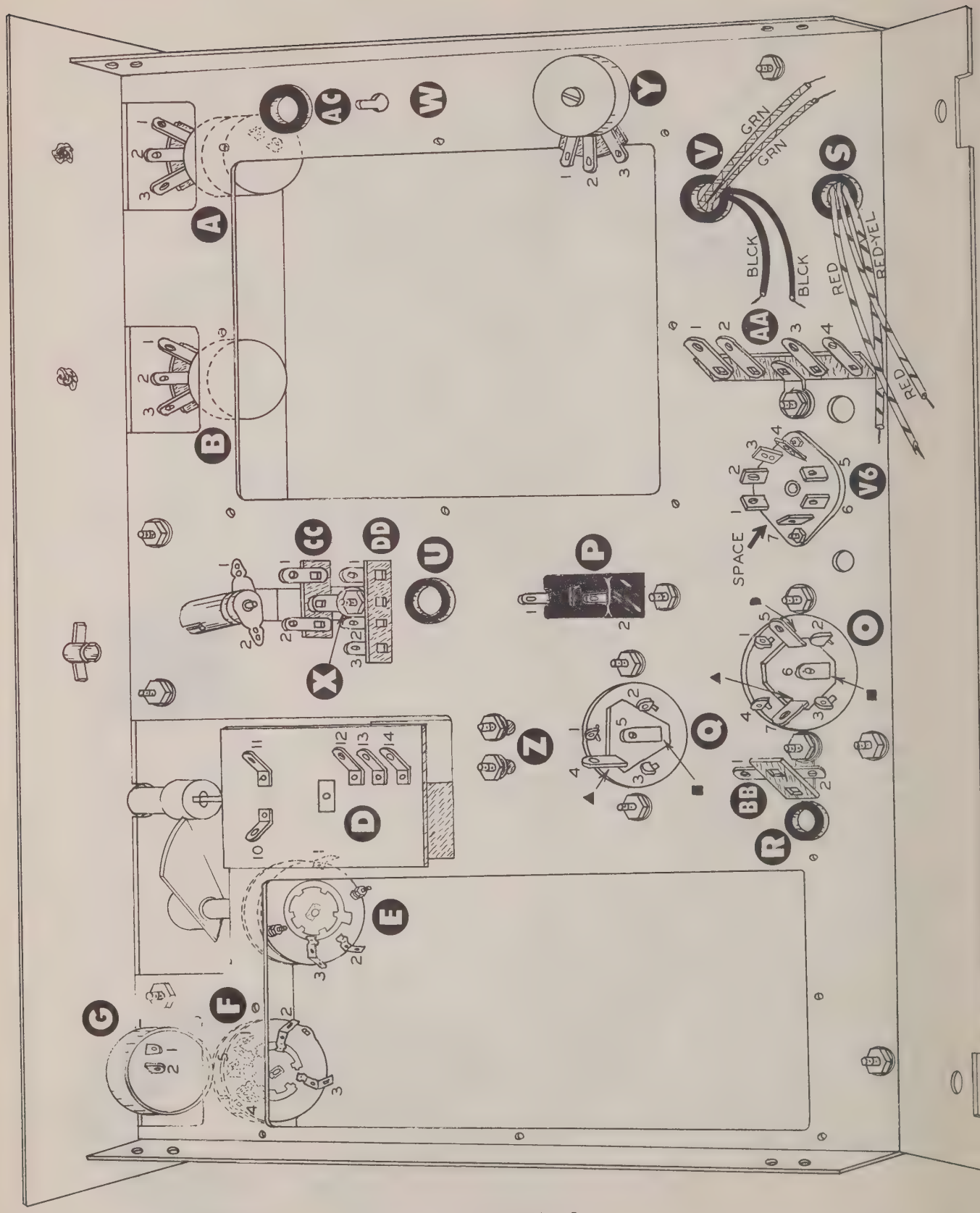
( ) Mount the 7-pin miniature tube socket at V6 from the underside of the chassis. Position the space as shown in Pictorial 2. Mount with 3-48 hardware. Lockwashers are not required.

( ) Mount the power transformer T1 as shown, with 6-32 hardware. Place a 4-lug terminal strip under one of the lockwashers as shown in Pictorial 2. Insert the two red leads and the red-yellow lead through grommet S, and the two black and two green leads through grommet V.

( ) Identify the spring clip (shown in the Parts Pictorial). Insert a 6-32 x 1/2" screw through its mounting hole, referring to Detail 4. Place this screw through the dimpled hole X from the top side of the chassis. From the bottom side of the chassis, mount the pilot light holder, 2-lug terminal strip and 3-lug terminal strip, by using three 6-32 lockwashers and a 6-32 x 1/4" hex nut. Detail 4 illustrates the mounting of these components and their respective positions. Tighten the nut securely while maintaining the proper positions.

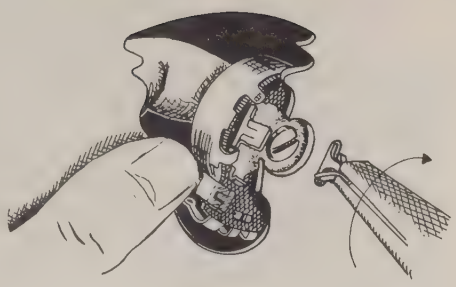



Detail 4


A
AC
W
Y
V
GRN
GRN
S
BLCK
BLCK
RED
RED-YEL
AA
B
V6
SPACE
GC
DD
U
P
X
O
Z
D
BB
R
E
F
G

PICTORIAL 2

( ) Mount the Filament Balance Control Y (#10-52) from the underside of the chassis by inserting the tabs through the holes as shown in Detail 5. Twist them 1/8 turn to securely mount the control.



Detail 5

( ) Identify the switch mounting bracket and mount Interlock Switch D as shown in Figure 11 on page 20. Use 6-32 hardware. Be sure the top deck (contains contacts 1-9) is up as shown.

( ) Referring to the same illustration, mount the rotary switch E (orient as shown). Place a lockwasher between the switch bushing and the bracket; insert the shaft through the hole in the switch bracket. Place a large flat washer on the shaft and secure with a control nut.

( ) Identify the Record Interlock Arm. Install the setscrew into the hole provided on the bushing and turn only enough to hold it in place.

( ) Study Figures 11 and 12 to become familiar with the placement and orientation of the Interlock Arm. (Note that the main body of the bushing is toward the front panel.) Place the Interlock Arm onto the shaft of switch E, but do not tighten the setscrew yet.

( ) Place the push button knob on the Interlock Switch shaft D and install the switch bracket assembly with 6-32 x 3/8" screws, #6 lockwashers and nuts. Tighten securely.

( ) Install the lever knob on the Function Switch E, and place it into the PLAY position. (If the knob does not align properly with the PLAY designation, loosen the control nut and rotate the switch; then retighten the nut securely.) Refer to Figure 12 and position the arm to just touch the base of the push button knob. Tighten the setscrew securely.

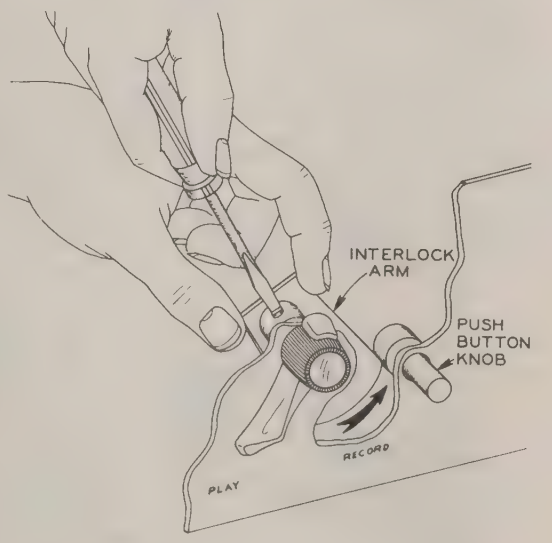



Figure 12

( ) Press the push button knob and operate the Function Switch E to the RECORD position. If the Function Switch cannot go into the RECORD position because the arm strikes the smaller diameter of the knob, loosen the nut on the switch bushing and reposition the switch upward slightly. Retighten the control nut securely. (If the Interlock Arm still strikes the smaller diameter of the push button knob, repeat the procedure outlined in this step.

( ) Install the shield bracket at Z with 6-32 x 3/8" screws, 1/8" spacers, #6 lockwashers and nuts. This shield is the flat rectangular (3/4" x 1 11/16") piece of aluminum which has two mounting holes at one end. This mounts on top of the chassis and extends between the switch decks on switch D. (See Pictorial 1, on Page 18.)

( ) Install the 40-20 mfd 300-300 volt capacitor on the capacitor mounting wafer Q. Position the lugs as shown. When the capacitor is seated firmly against the wafer, twist the mounting lugs 1/8 of a turn (45°). (The ■ lug should be toward the rear chassis apron.)

( ) Similarly, install the 20-20-40 mfd 400-400-350 volt capacitor at O. (Again, the ■ lug should be toward the rear chassis apron.)

( ) Install the Playback Circuit Board (85-21) on top of the chassis, using 3-48 hardware; refer to Pictorial 3 on Page 26. Notice that there is no mounting hole near the front panel adjacent to the switch cutout.

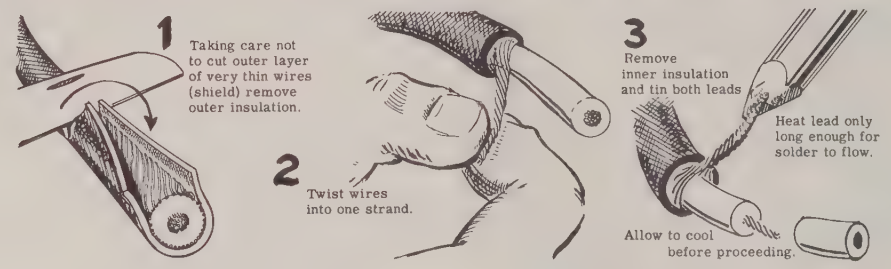
( ) Remove the 3-48 hardware holding terminal strip HH on the circuit board.
( ) Install the Record Circuit Board (85-22) on top of the chassis, using 3-48 hardware, making sure that the oscillator coil (T2) can is toward the rear of the chassis.

## PROPER SOLDERING PROCEDURE

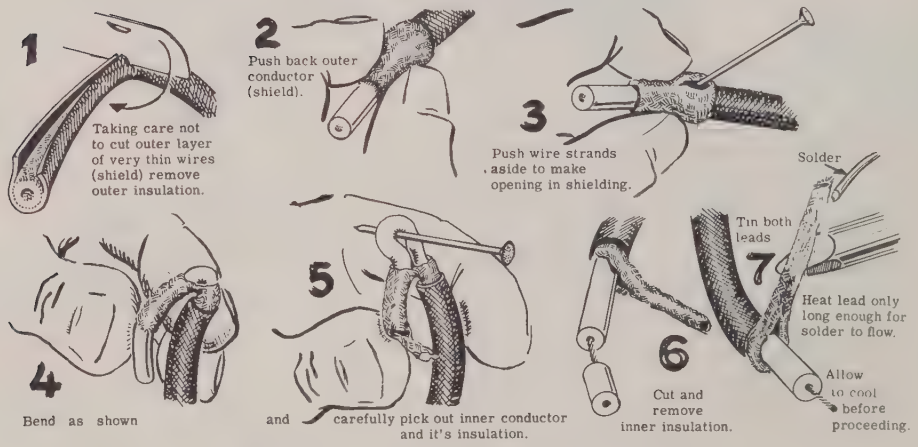
Only a small percentage of Heathkit purchasers find it necessary to return an instrument for factory service. Of these, by far the largest proportion function improperly due to poor or improper soldering.

Correct soldering technique is extremely important. Good solder joints are essential if the performance engineered into the kit is to be fully realized. If you are a beginner with no experience in soldering, a half-hour's practice with odd lengths of wire and a tube socket will be a worthwhile investment.

The following general instructions are given for use in preparing both types of shielded cable. Specific illustrations with dimensions will be given with the individual step.


1
Taking care not to cut outer layer of very thin wires (shield) remove outer insulation.
2
Twist wires into one strand.
3
Remove inner insulation and tin both leads
Heat lead only long enough for solder to flow.
Allow to cool before proceeding.

TWISTED SHIELD PREPARATION


1
Taking care not to cut outer layer of very thin wires (shield) remove outer insulation.
2
Push back outer conductor (shield).
3
Push wire strands aside to make opening in shielding.
Solder
Tin both leads
7
Heat lead only long enough for solder to flow.
Allow to cool before proceeding.
4
Bend as shown
5
and carefully pick out inner conductor and it's insulation.
6
Cut and remove inner insulation.

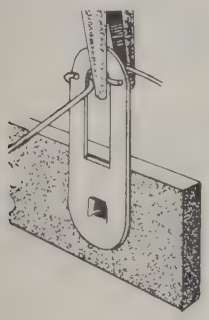
BRAIDED SHIELD PREPARATION

High quality solder of the proper grade is most important. There are several different brands of solder on the market, each clearly marked "Rosin Core Radio Solder." Such solders consist of an alloy of tin and lead, usually in the proportion of 50:50. Minor variations exist in the mixture such as 40:60, 45:55, etc. with the first figure indicating the tin content. Radio solders are formed with one or more tubular holes through the center. These holes are filled with a rosin compound which acts as a flux or cleaning agent during the soldering operation.

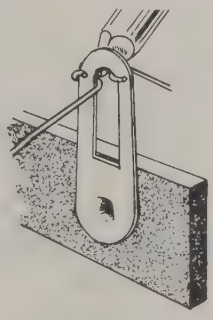
NO SEPARATE FLUX OR PASTE OF ANY KIND SHOULD BE USED. We specifically caution against the use of so-called "non-corrosive" pastes. Such compounds, although not corrosive at room temperatures, will form residues when heated. The residue is deposited on surrounding surfaces and attracts moisture. The resulting compound is not only corrosive but actually destroys the insulation value of non-conductors. Dust and dirt will tend to accumulate on these "bridges" and eventually will create erratic or degraded performance of the instrument.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. WHEN IN DOUBT ABOUT SOLDER, IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.

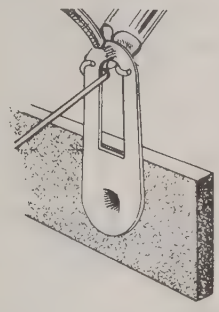
If terminals are bright and clean and wires free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Crimp or otherwise secure the wire (or wires) to the terminal, so a good joint is made without relying on solder for physical strength. To make a good solder joint, the clean tip of the soldering iron should be placed against the joint to be soldered so that the terminal is heated sufficiently to melt solder. The solder is then placed against both the terminal and the tip of the iron and will immediately flow out over the joint. Use only enough solder to cover wires at the junction; it is not necessary to fill the entire hole in the terminal with solder. Excess solder may flow into tube socket contacts, ruining the socket, or it may creep into switch contacts and destroy their spring action. Position the work so that gravity tends to keep the solder where you want it.



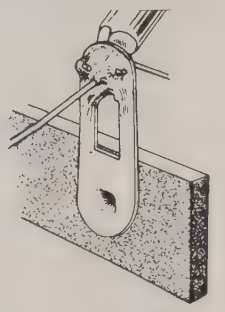
CRIMP WIRES



HEAT CONNECTION

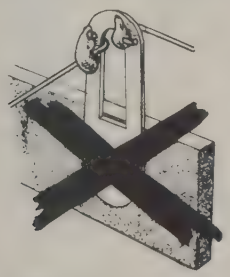


APPLY SOLDER

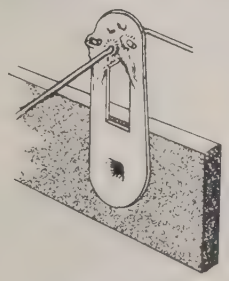


ALLOW SOLDER TO FLOW

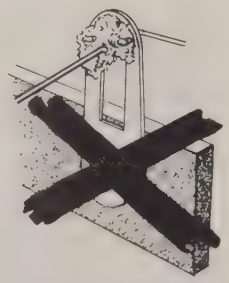
A poor solder joint will usually be indicated by its appearance. The solder will stand up in a blob on top of the connection, with no evidence of flowing out caused by actual "wetting" of the contact. A crystalline or grainy texture on the solder surface, caused by movement of the joint before it solidified is another evidence of a "cold" connection. In either event, reheat the joint until the solder flows smoothly over the entire junction, cooling to a smooth, bright appearance.



COLD SOLDER JOINT
CONNECTION INSUFFICIENTLY HEATED



PROPER SOLDER CONNECTION



COLD SOLDER JOINT
CONNECTION MOVED WHILE COOLING

A good, clean, well-tinned soldering iron is also important to obtain consistently perfect connections. For most wiring, a 30 to 100 watt iron, or the equivalent in a soldering gun, is very satisfactory. Smaller irons generally will not heat the connections enough to flow the solder smoothly over the joint and are recommended only for light work, such as on etched circuit boards, etc. Keep the iron tip clean and bright. A cloth may be used to wipe the tip occasionally during use.

Follow this procedure and use reasonable care during assembly of the kit. This will insure the wonderful satisfaction of having the instrument operate perfectly the first time it is turned on.

BLCK
BLCK
BLCK
BLCK
BLCK
BLCK
GRN
GRN
GRN
BLCK
BLCK
RED
RED
RED-YEL
SPACE
GRND
Heathkit
PART NO 85-21

PICTORIAL 3

## STEP-BY-STEP WIRING PROCEDURE

Generally refer to the Pictorials opposite each page of steps for visual information; in addition, supplementary illustrations will be specified in some steps.

NOTE: In the following steps, a wire which is cut to a specified length will normally have 1/4" of insulation stripped from both ends.

( ) Cut a 3 1/2" length of black wire. Connect one end to control lug A-3 (NS) and the other end to control lug B-3 (NS).

( ) Prepare a length of black wire 7 1/8" in length. Connect one end to control lug B-3 (NS), and after positioning the wire as shown in Pictorial 3, connect the other end of the wire to lug DD-3 (NS) of the 3-lug terminal strip DD.

( ) After preparing a 2 7/8" length of black wire; connect one end to lug DD-3 (NS) and the other end to electrolytic capacitor lug Q-1 (NS).

( ) Cut a black wire 4 7/8" long. Connect one end to lug Q-1 (NS). Insert the free end of this wire through grommet U and leave the end free temporarily.

( ) Prepare a 1 1/2" black wire and connect it between ground lug Q-2 (S1) on capacitor Q and ground lug O-4 (NS), electrolytic capacitor O.

( ) A 3" black wire must now be prepared. Connect one end to lug DD-3 (NS) and the other end to terminal D-4 (NS) on switch D. Position as shown in Pictorials 3 and 8.

( ) A 5 3/4" black wire must now be connected between capacitor lug Q-1 (NS) and the hole marked GRND on the foil side of circuit board #85-22 (S1).

NOTE: The majority of the ground circuit for the preamplifier has just been installed. The next section that will be installed will be the filament circuits. Locate all twisted green wires close to the chassis because they will be carrying alternating current which could produce hum in the amplifier.

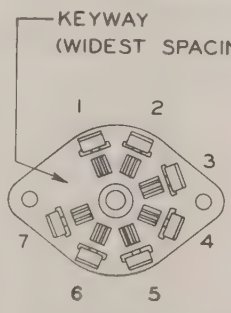
( ) Prepare two green wires in the same manner as outlined above. One of these wires should be 5 3/4" long and the other 6 3/8" long.

( ) Connect one end of the longer green wire to tube socket pin V6-3 (NS).

( ) Connect one end of the shorter green wire to tube socket pin V6-4 (NS).

( ) Twist the two wires together and position the two wires toward Control Y, as shown in Pictorial 3.

( ) Connect the shorter of the two wires to Control Lug Y-3 (NS) and the longer of the two to Y-1 (NS).

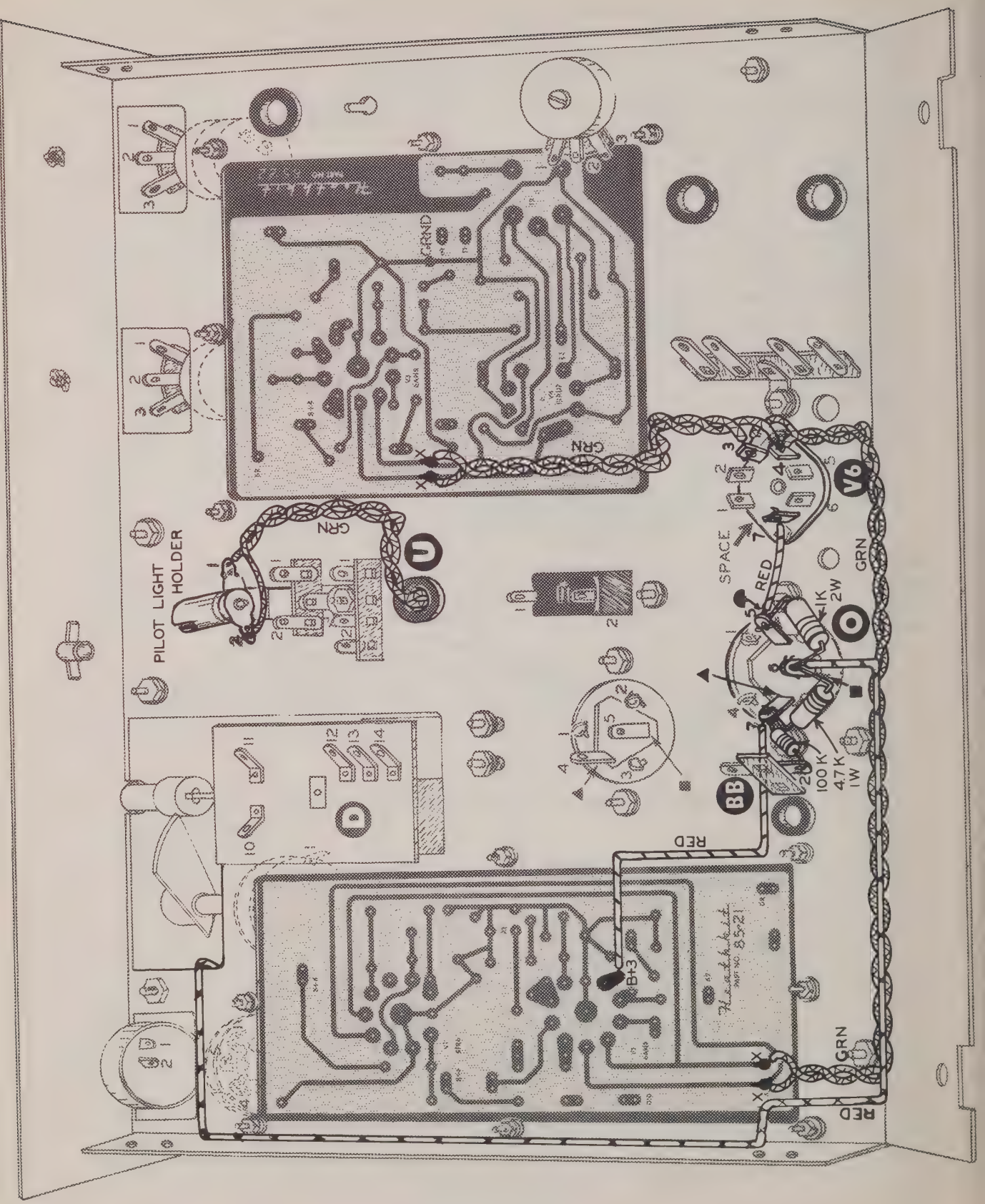


7 PIN TUBE
SOCKET BOTTOM VIEW

( ) Cut and strip the ends of two more green wires, one 8 3/4" long and the other 7 3/4" long.

( ) Connect one end of the longer wire to tube socket pin V6-3 (NS) and the shorter one to pin V6-4 (NS). Twist the leads so that the shorter of the two may be connected to the pilot light holder terminal 1 (NS), and the longer of the two may be connected to terminal 2 of the pilot light holder (NS).

( ) To prepare another set of green wires, cut one 5 1/2" long and the other 5 1/4" long.


GRND
GRN
PILOT LIGHT HOLDER
SPACE
RED
1K 2W
GRN
100 K
4.7 K 1W
RED
B+3
GRN
RED

PICTORIAL 4

( ) Connect the longer wire to pin V6-4 (NS).

( ) Connect the shorter wire to V6-3 (NS).

( ) Twist the two wires together as in the previous steps and route them so that they may be soldered into the holes marked "X" on the foil side of circuit board 85-22 (S1). Either wire may go to either hole.

( ) Cut two green wires to a length of 10".

( ) Connect one of the wires to pin V6-4 (S4).

( ) Connect the other wire to pin V6-3 (S4).

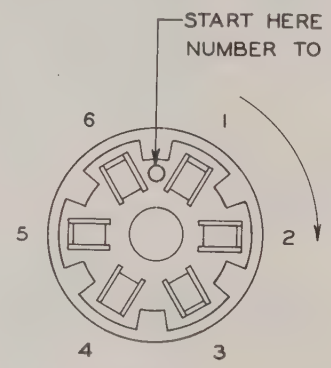
( ) Form these wires into a twisted pair and route them so that they may be soldered into the holes marked "X" on the foil side of circuit board 85-21. As mentioned before, filament leads should be positioned close to the chassis to reduce hum and so that they are out of the way. Now solder both connections.

( ) Another set of green wires must now be cut: one 6" long and the other 7" long.

( ) Connect the shorter of the two wires to terminal 1 of the pilot light holder (S2).

( ) Connect the longer to terminal 2 of the pilot light holder (S2).

( ) Follow the same twisting procedure, insert the two wires through grommet U. Connect one wire to pin V5-1 (S1) on the eye tube socket V5, and the other wire to V5-6 (S1). See Pictorials 4 and 8.



6 PIN TUBE
SOCKET BOTTOM VIEW

This completes the filament wiring. The B+ and the power supply circuits will now be installed in an order which should provide the most working clearance. All B+ wiring will be constructed using red wire.

( ) Prepare a 1 5/8" red wire and connect it between pin V6-7 (S1) and electrolytic capacitor lug O-5 (NS).

( ) Cut both leads of a 1 K ohm 2 watt resistor (largest size) (brown-black-red) to 3/4" length and connect it between lug O-5 on capacitor O (S2) and lug O-6 (NS).

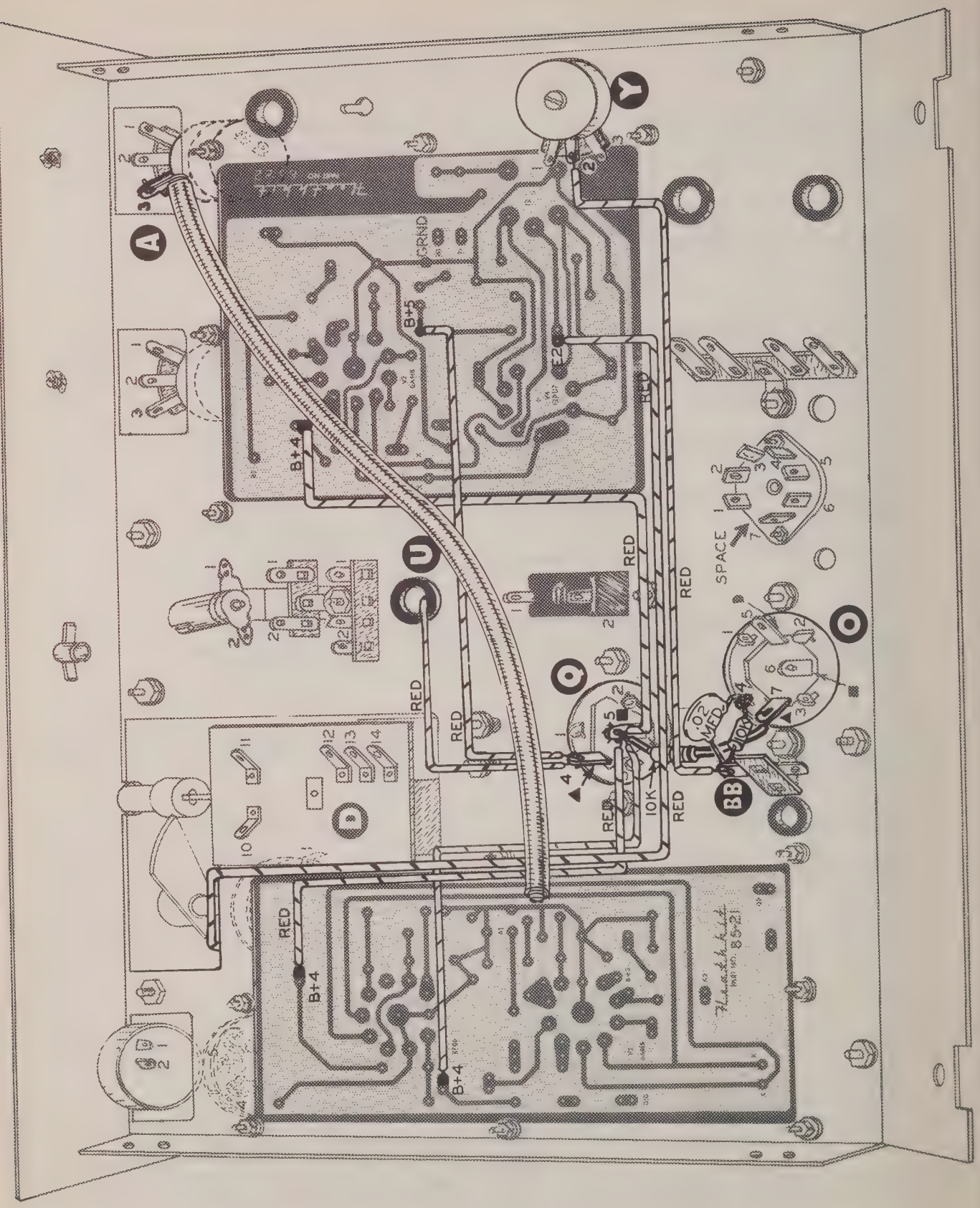
( ) Connect a 15 1/2" red wire to lug O-6 (NS) and route it around the corner of the chassis as shown in Pictorial 4.

( ) Connect the other end to switch lug E-3 (NS). See Pictorial 8.

( ) Trim both leads of a 4.7 K ohm 1 watt resistor (medium size) (yellow-violet-red) to 5/8". Connect this resistor between filter capacitor lug O-6 (S3) and lug O-7 (NS). Position as shown in Pictorial 4 so that sufficient space remains for additional connections.

( ) Prepare a 4 1/2" red wire. Connect one end of this wire to capacitor lug O-7 (NS) and the other end to the hole marked "B+3" (S1) on the foil side of circuit board #85-21.

( ) Cut both leads of a 100 K ohm resistor (brown-black-yellow) to 1/2". Connect one end to capacitor lug O-7 (NS) and the other to lug BB-2 (S1) of terminal strip BB.




PICTORIAL 5

( ) After clipping the leads of a 10 K ohm resistor (brown-black-orange) to 7/8", cut two pieces of sleeving 1/2" long. Place the sleeving over the resistor leads, then connect one end of resistor to capacitor lug O-7 (S4) and the other end of the resistor to capacitor lug Q-5 (NS).

( ) Cut both leads of a 10 K ohm resistor (brown-black-orange) to a length of 1/2" and connect the resistor between capacitor lug O-4 (NS) and terminal strip lug BB-1 (NS).

( ) After cutting both leads of a .02 mfd ceramic disc capacitor to 5/8", connect it between capacitor lug O-4 (S3) and terminal strip lug BB-1 (NS).

( ) Prepare an 8 5/8" red wire and connect one end to terminal strip lug BB-1 (S3).

( ) Route the lead as shown in Pictorial 5, and connect the other end to Y-2 (S1) of the Filament Balance Control Y.

( ) Prepare a red wire 6 1/8" long. Connect one end to capacitor lug Q-5 (NS) and the other end to the B+4 (S1) point located near the left edge of the foil side of circuit board #85-21.

( ) After cutting and preparing a 6 1/2" red wire, connect one end to capacitor lug Q-5 (NS). The other end of this wire must be connected to the other B+4 (S1) point, which is located toward the front panel edge of the foil side of the circuit board #85-21.

( ) Cut and strip the ends of a 6" red wire; connect one end to capacitor lug Q-4 (NS) and the other end to B+5 on the foil side of the circuit board #85-22 (S1).

( ) Prepare a 7 1/8" red wire and connect one end to capacitor lug Q-5 (S4). The other end must be inserted into the B+4 (S1) point on the foil side of circuit board #85-22.

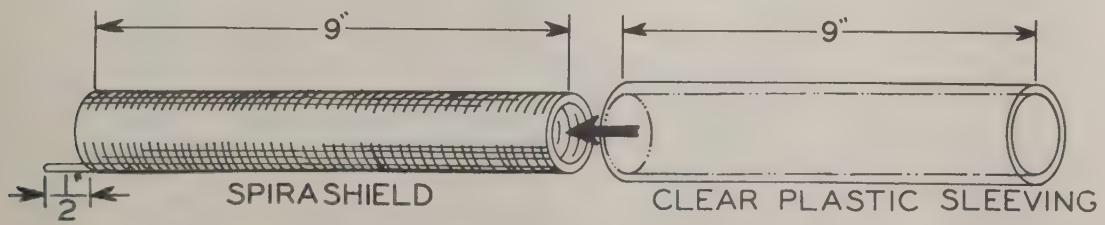
( ) A 5 3/4" red wire will be needed in this step. Connect one end to capacitor lug Q-4 (S2) and insert the other end of this wire through grommet U; leave this end free temporarily.

( ) Prepare a 14 1/8" red wire and connect one end to E-2 (NS) on Function Switch E. Connect the other end to point E-2 on the foil side of the circuit board #85-22 (S1). See Pictorials 5 and 8.

This completes the wiring of the B+ and power supply. The signal circuits will be wired next.

NOTE: Inserting the spirashield into the clear plastic sleeving will be made much easier if air is forced through first, by blowing into the tubing.

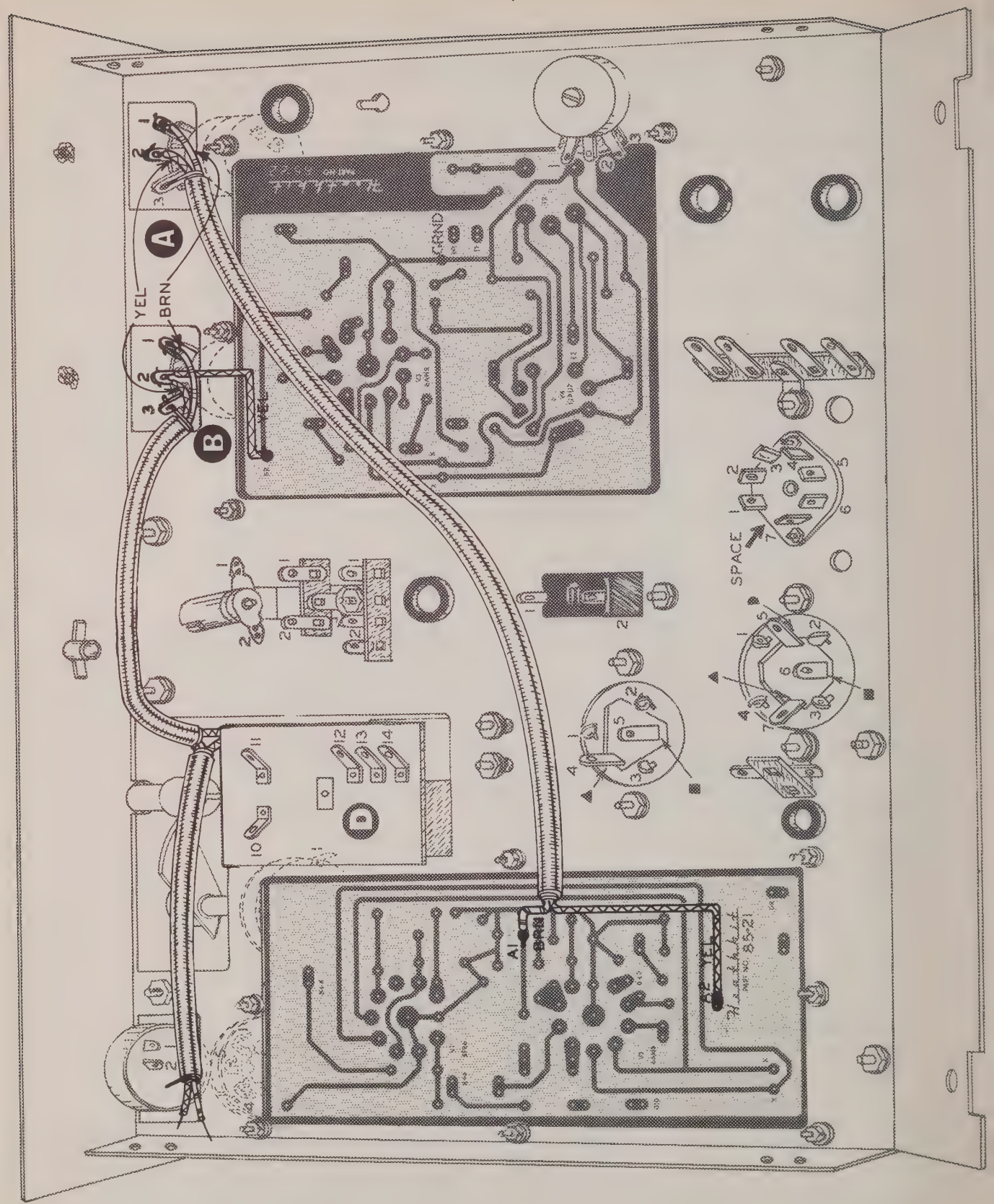
( ) Cut a piece of spirashield 9" long and unwind <u>one</u> end so that about 1/2" of wire is straightened. See Detail 6.




Detail 6

( ) Cut a piece of clear plastic sleeving to a length of 9". Insert the spirashield into the sleeving.

( ) Connect the end of the spirashield that was unwound to lug A-3 (S2) on Playback Gain Control A.




PICTORIAL 6

( ) Cut a piece of brown wire 11 3/4" long and a piece of yellow wire 13 5/8" long. Strip only one end of each. Thread the unstripped ends through the spirashield from the end at Control "A". Connect the yellow wire to lug A-2 (S1) on Control A.

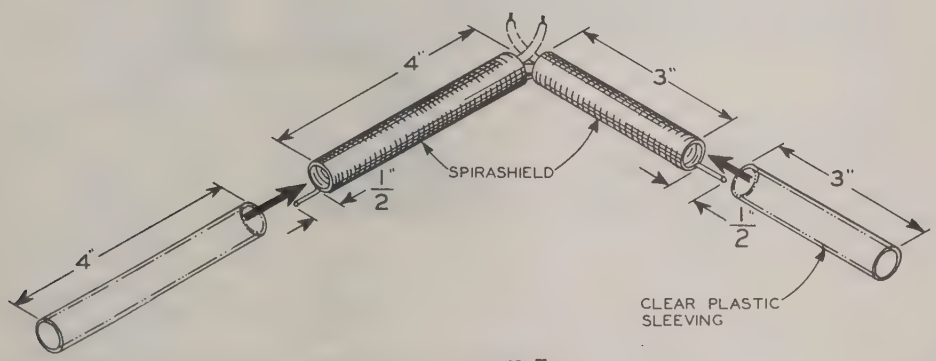
( ) Connect the brown wire to lug A-1 (S1).

( ) Remove 1/4" of insulation from the remaining ends and refer to Pictorial 6 in order to properly position the spirashield.

( ) Connect the brown wire to hole "A-1" (S1) on the foil side of circuit board #85-21.

( ) Connect the yellow wire to "A-2" (S1) on the foil side of circuit board #85-21.

( ) Cut a piece of spirashield 7" long. Bend the spirashield so that an opening is created 3" from one end. (Refer to Detail 7). Cut two pieces of the clear plastic sleeving: one 3" long and the other 4" long. Use the longer piece of clear plastic to encase the longer end of the spirashield and the shorter piece on the other side of the opening. Unwind the spirashield so that 1/2" of straightened shielding is obtained at both ends. Connect the shorter end of the spirashield to lug B-3 (S3) on Control B. Lay the shielding across the front of the chassis temporarily.




Detail 7

( ) Prepare a 2 5/8" length of yellow wire and connect one end to lug B-2 (NS) of the Record Gain Control B.

( ) Connect the other end of this wire to "B2" (S1) on the foil side of circuit board #85-22.

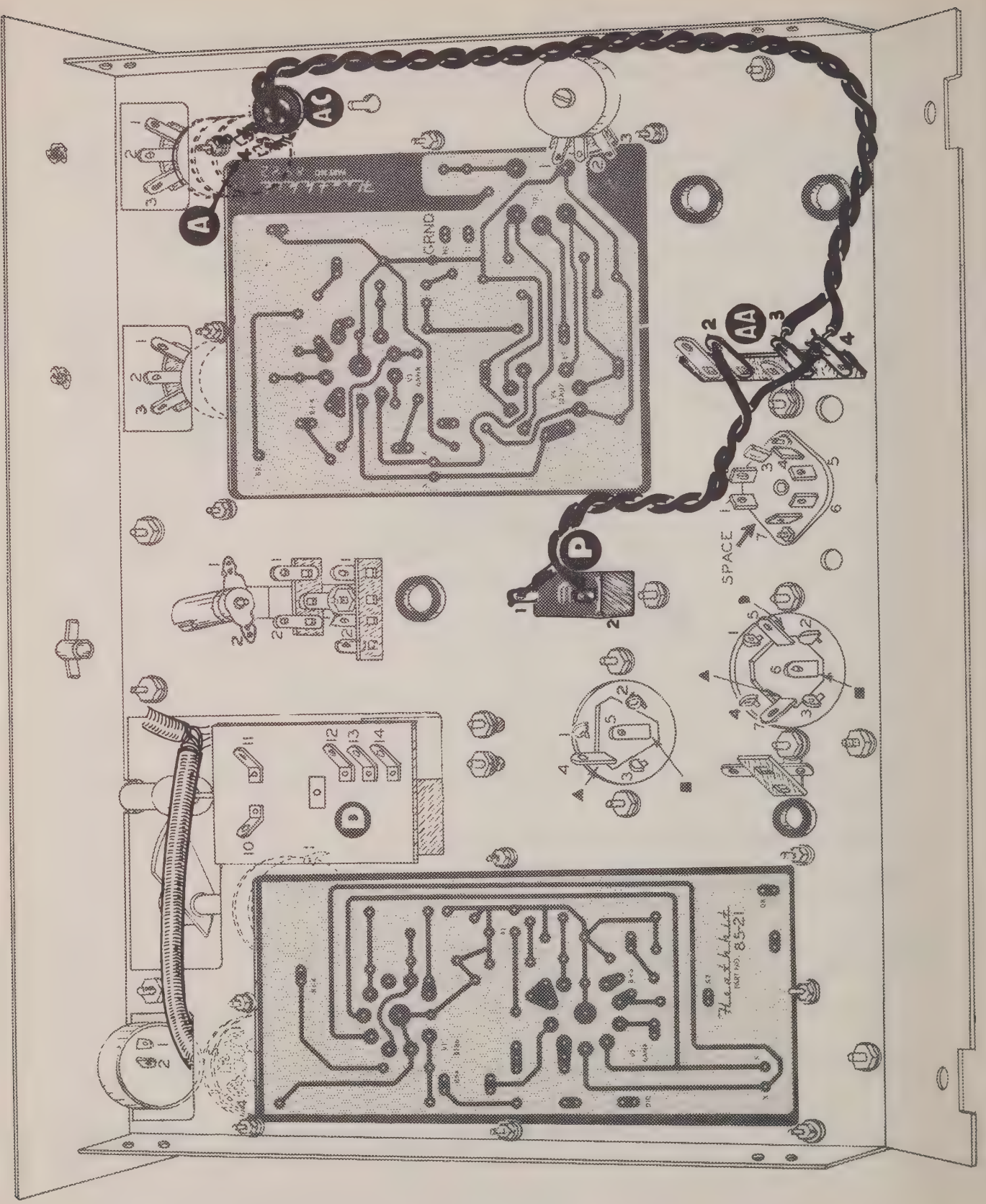
( ) Cut a 6 1/4" length of yellow wire and thread it through the shorter section of the spirashield which was just prepared.

NOTE: The lead will slide through the spirashield easier if the end of the wire is stripped after it is inserted.

( ) Prepare a 10 1/2" length of brown wire and thread it through the entire length of the spirashield.

( ) Connect the yellow wire which extends from the shorter length of the spirashield to lug B-2 (S2) on Record Gain Control B.

( ) Connect the brown wire which extends from the same end of the spirashield to lug B-1 (S1).




PICTORIAL 7

( ) The break in the spirashield should fall approximately alongside Switch D (refer to Pictorial 6). Run the yellow wire, coming from the break, through the opening in the chassis which is next to the switch.

( ) Connect the yellow lead to lug D-1 (S1) on push button Switch D. See Pictorial 8.

( ) Prepare a yellow lead 8 1/2" long and thread it through the longer end of the spirashield. Allow it to extend through the break only enough to enable it to be connected to lug D-3 (S1) on Pushbutton Switch D. Refer to Pictorial 8.

( ) Insert the free end of the spirashield into the hole in the chassis directly below Equalization Switch G. Refer to Pictorial 7.

( ) Connect the straightened part of the spirashield to terminal F-4 (NS) of the Input Selector Switch F. Refer to Pictorial 8.

( ) Now the two wires extending from this end of the spirashield should naturally lay close to the switch. Connect the brown wire to lug F-2 (S1) of Switch F. Connect the yellow wire to lug F-5 (NS) on Switch F.

( ) Trim both leads of a .02 ceramic disc capacitor to 7/8". Connect one end of this capacitor to lug F-1 (S1). Connect the other end to switch lug F-5 (S2).

( ) Prepare a 1 3/4" black lead and connect it between lug L-2 on phono jack L (NS) and lug K-2 (S1) on phono jack K. Refer to Pictorial 8.

( ) Cut another 1 3/4" black wire and connect one end to lug J-2 of phono jack J (NS), and the other end to lug H-2 of phono jack H (NS). Refer to Pictorial 8.

( ) Prepare two black leads, one 5 1/4" long and the other 6 1/4" long.

( ) Connect one end of one lead to lug P-1 (S1) of the 117 volt power socket P.

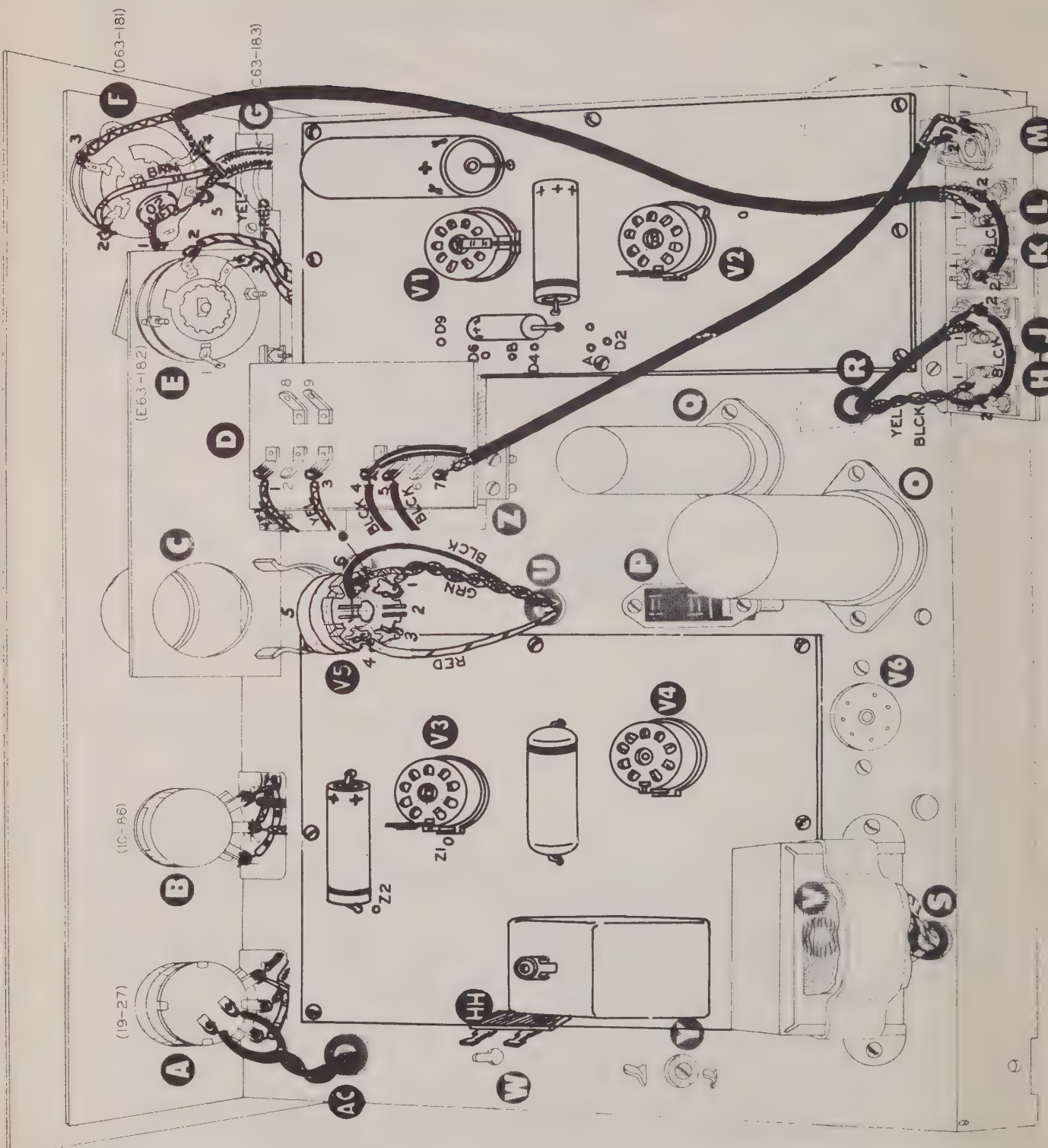
( ) Connect one end of the other lead to P-2 (S1).

( ) Twist the two wires together and connect the shorter to lug AA-2 (NS) of terminal strip AA.

( ) Connect the longer of the two to lug AA-4 (NS).

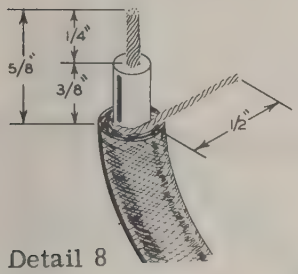
( ) Cut two black wires 14 1/2" in length and prepare as usual. Fasten one wire to lug AA-3 (NS) on terminal strip AA; connect the other wire to lug AA-4 (NS). Twist the pair together and route along the edge of the chassis so that they will extend through grommet AC. Connect either wire to Playback Gain Control lug A-4 (S1) and the remaining wire to control lug A-5 (S1). These wires should also be positioned close to the chassis.

( ) Prepare a yellow lead 11 3/4" long in the usual manner, then cut a black lead 11 3/4" long but trim the insulation from one end only. Connect the yellow lead to lug H-1 of phono jack H (S1); connect the black lead to phono jack lug H-2 (S2). Refer to Pictorial 8.

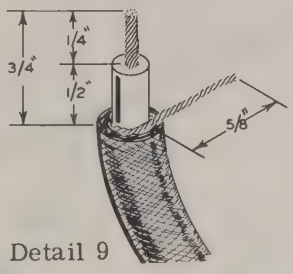

(D63-181)
(C63-183)
(E63-182)
(10-86)
(19-27)
BRN
YEL
RED
BLCK
GRN
V1
V2
V3
V4
V5
V6
D9
D6
D4
D2
Z1
Z2

PICTORIAL 8

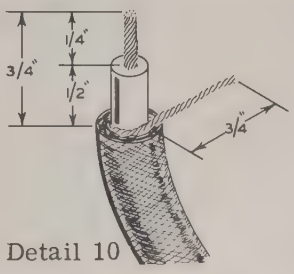
( ) Twist the two wires together and insert them through rubber grommet R, which is located in the chassis directly below phono jack H. Connect the yellow lead to point "H-1" (S1) on the foil side of circuit board #85-22. Notice that the end of the black lead which you did not strip is not connected at this end because it is being used as a shield. It should be left tightly twisted. Refer to Pictorials 8 and 10



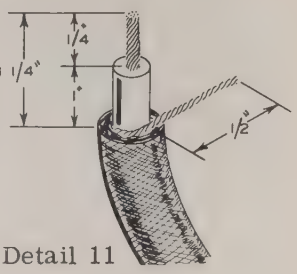
Detail 8



Detail 9



Detail 10



Detail 11

( ) Cut a piece of shielded cable 7" long and prepare one end as shown in Detail 8. Connect the outside shield of the cable to lug J-2 (S2) of phono jack J. Refer to Pictorial 8.

( ) Connect the center conductor of the shielded cable to lug J-1 (S1) of phono connector J.

( ) Run the shielded cable through the grommet which is directly below phono jack J and H. Notice that there is also a black and yellow wire through this grommet.

( ) Prepare the other end of the shielded cable so that about a 5/8" length of outer conductor shield may be used. Connect this shield to lug DD-3 of terminal strip DD (NS). See Detail 9 and Pictorial 10.

( ) Connect the inner conductor to terminal D-13 (S1) on switch D.

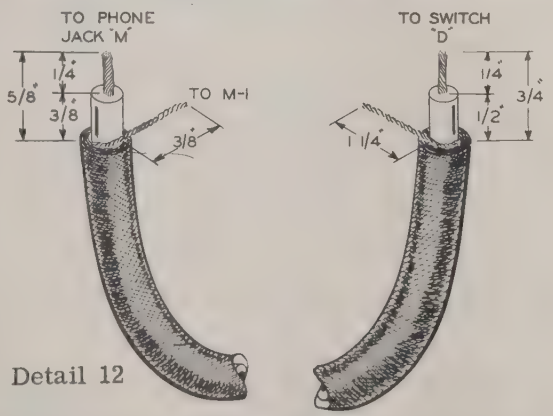
( ) Cut a piece of shielded cable 9" long and prepare one end of the shielded lead as shown in Detail 10. Connect the outer shield of this cable to lug L-2 (S2) of phono jack L and the inner conductor to lug L-1 (S1). Refer to Pictorial 8.

( ) Prepare the other end of the shielded cable as shown in Detail 11. Route the cable so that the outer conductor may be fastened to lug F-4 on switch F (S2). Connect the inner conductor to lug F-3 (S1) of the same switch.

( ) Prepare both ends of a 7 1/2" length of shielded cable as shown in Detail 12, and connect the shorter outer shield to lug M-2 (S1) of phone jack M. Then connect the center conductor of the same end to lug M-1 (S1) of phone jack M.

( ) Connect the longer outer shield of the other end of this shielded cable to lug D-4 (NS) on switch D. Use sleeving on the shield.

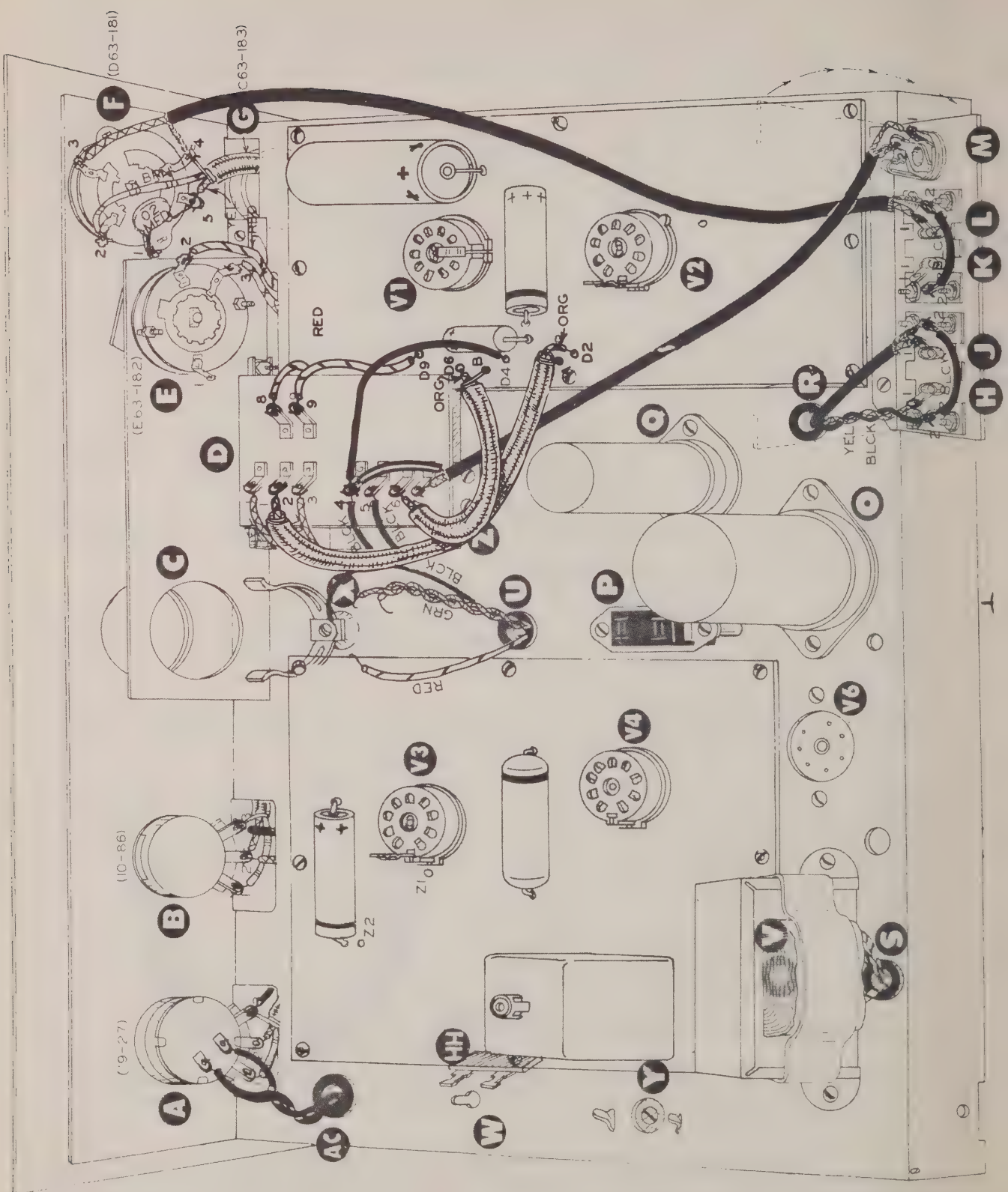
( ) Connect the center conductor to lug D-7 (S1).



Detail 12

( ) Prepare a black wire 2 3/4" long and connect one end to lug D-5 (S1) on switch D. Run this wire through the chassis next to switch D and connect to lug D-12 (S-1) of the same switch Refer to Pictorials 8 and 10.

( ) Prepare an orange wire 7 1/4" long and connect one end to lug "D-10" (S1) of Switch D. Route this wire so that it may be connected to point "D-10" (S1) on the foil side of circuit board #85-21. Refer to Pictorial 10.


(D63-181)
(C63-183)
(E63-182)
(10-86)
(9-27)
RED
ORG
BLCK
GRN
YEL
V1
V2
V3
V4
V6
Z1
Z2
D2
D4
D6
D9

PICTORIAL 9

( ) Prepare a red wire 2 3/4" long and connect one end to lug D-9 (S1) on Switch D.

( ) Connect the other end to point "D-9" (S1) on the component side of circuit board #85-21.

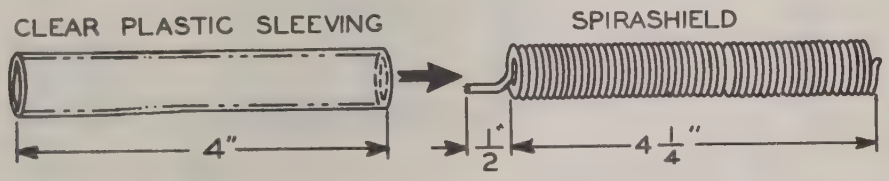
( ) Prepare a red wire 8 7/8" long and connect one end to lug D-8 (S1) on Switch D.

( ) Connect the other end of this wire to hole "D-8" (S1) on the foil side of circuit board #85-21. Make certain this lead goes through the chassis and is routed along the edge of the circuit board (see Pictorials 9 and 10 for exact routing).

( ) Cut and prepare a black wire 4" long and connect one end to lug D-4 (S3) on Switch D.

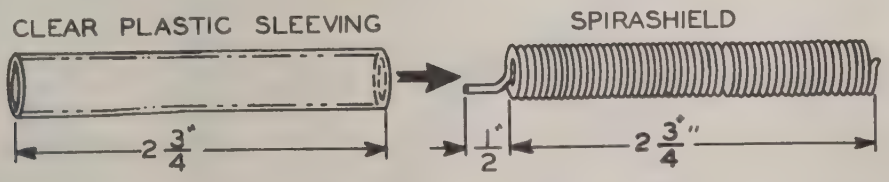
( ) Connect the other end of this wire to point "D-4" (S1) on the component side of circuit board #85-21.

( ) After cutting a piece of spirashield 4 1/4" long, unwind about 1/2" from one end. Cut a piece of clear plastic sleeving 4" long and thread the spirashield into it. Insert the unwound end of the spirashield into the hole at point "A" (S1) on the component side of circuit board #85-21.




Detail 12

( ) Cut a piece of orange wire 5 1/2" long and strip both ends of the wire. (This wire should easily be threaded through the spirashield.) Insert one end of this orange wire into the hole at point "D-2" (S1) on the component side of circuit board #85-21. Connect the other end of this wire to Switch lug D-2 (S1).




Detail 13

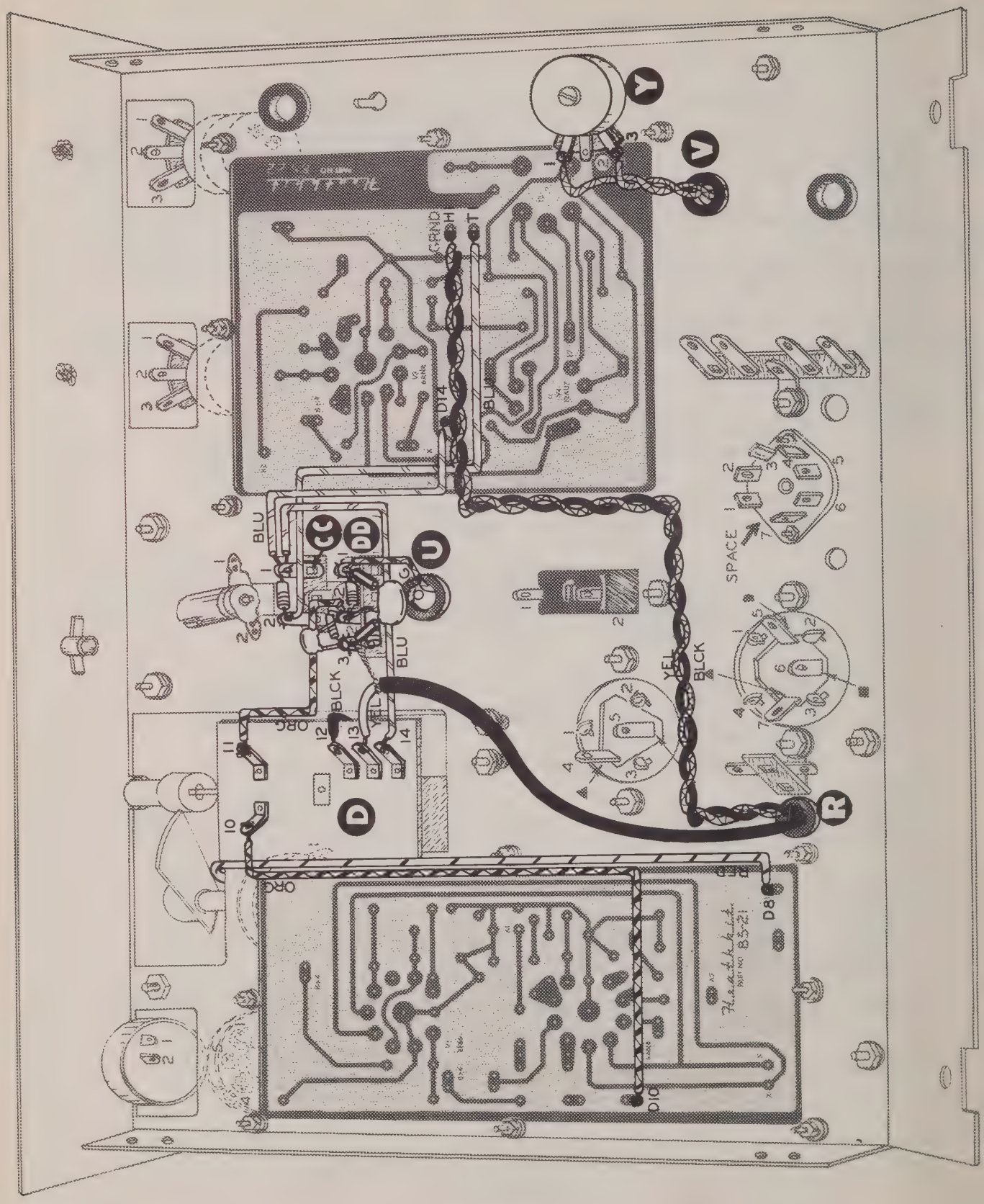
( ) Prepare another length of spirashield 2 3/4" long, and unwind 1/2" from one end only. Cover this piece of spirashield with a 2 3/4" length of clear plastic.

( ) Insert the unwound end of the spirashield into the hole at point "B" (S1) on the component side of circuit board #85-21.

( ) Prepare a piece of orange wire 3 7/8" long and thread it through the spirashield which was just mounted on circuit board #85-21.

( ) Connect one end of the orange wire into the hole labeled "D-6" (S1) on the component side of circuit board #85-21.

( ) Connect the other end of this wire to lug D-6 (S1) on Switch D.




PICTORIAL 10

( ) Prepare a blue wire 6 3/4" long and connect one end to lug CC-2 (NS) of terminal strip CC.
( ) Connect the other end of this wire to the hole at point "T-1" (S1) on the foil side of circuit board #85-22.
( ) Prepare a blue wire 3 1/4" long and connect one end to lug CC-1 (NS) of 2-lug terminal strip CC.
( ) Connect the other end to point "D-14" (S1) on the foil side of circuit board #85-22.
( ) Prepare another blue wire 4 1/2" long and connect one end to lug CC-1 (NS) of terminal strip CC.
( ) Connect the other end to switch lug D-14 (S1).

( ) Cut both leads of a(n) { TR-1A: 82 KΩ (gray-red-orange) / TR-1AH: 68 KΩ (blue-gray-orange) / TR-1AQ: 180 KΩ (brown-gray-yellow) } resistor

to 1/2". Connect this resistor between lug CC-1 (S3) and lug CC-2 (S2) on terminal strip CC. This is R27 in Figure 13 below.

( ) Prepare an orange lead 4" long and connect one end to terminal strip lug DD-1 (NS).

( ) Insert the other end through the grommet U. Leave this end free temporarily.

( ) Cut both leads of a 1 megohm resistor (brown-black-green) to 1/2". Connect this resistor between lug DD-1 (NS) of terminal strip DD and lug DD-2 (NS).

( ) Prepare an orange wire 2 5/8" long and connect one end to switch lug D-11 (S1).

( ) Connect the other end of this wire to lug DD-2 (NS) of terminal strip DD.

( ) Bend the leads of a 100 K ohm resistor (brown-black-yellow) to form right angles with the resistor body and trim them to a length of 3/8". Connect this resistor between lug DD-2 (NS) and lug DD-3 (NS) of terminal strip DD.

NOTE: In the next step, the red band or similar marking, designating the cathode end of the crystal diode, should be toward terminal DD-3. (See diode chart on Parts Pictorial).

( ) Cut the leads of the crystal diode 56-4 to a length of 1/2". Connect the crystal diode between lug DD-2 (NS) and lug DD-3 (NS). The leads on this diode should be heated only enough to satisfactorily make a solder joint as the crystal diode may be affected by excessive heat. Note position of the red band.
( ) Cut both leads of a 220 mmfd capacitor to 3/8" and connect one end to lug DD-2 (S5) of terminal strip DD. Connect the other end of this capacitor to lug DD-3 of the same terminal strip (NS).
( ) Cut the leads of a .01 mfd 50 v capacitor to a length of 3/4" and connect one lead to lug DD-1 (S3) of terminal strip DD (use sleeving on both leads). Connect the other end to lug DD-3 (S8) of terminal strip DD.

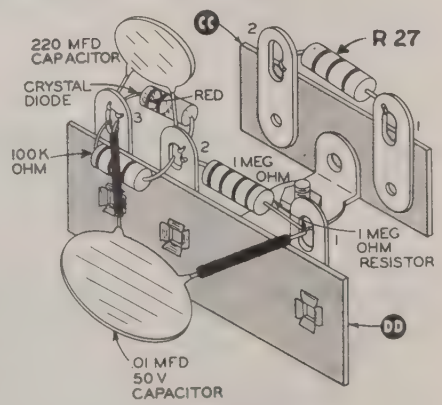
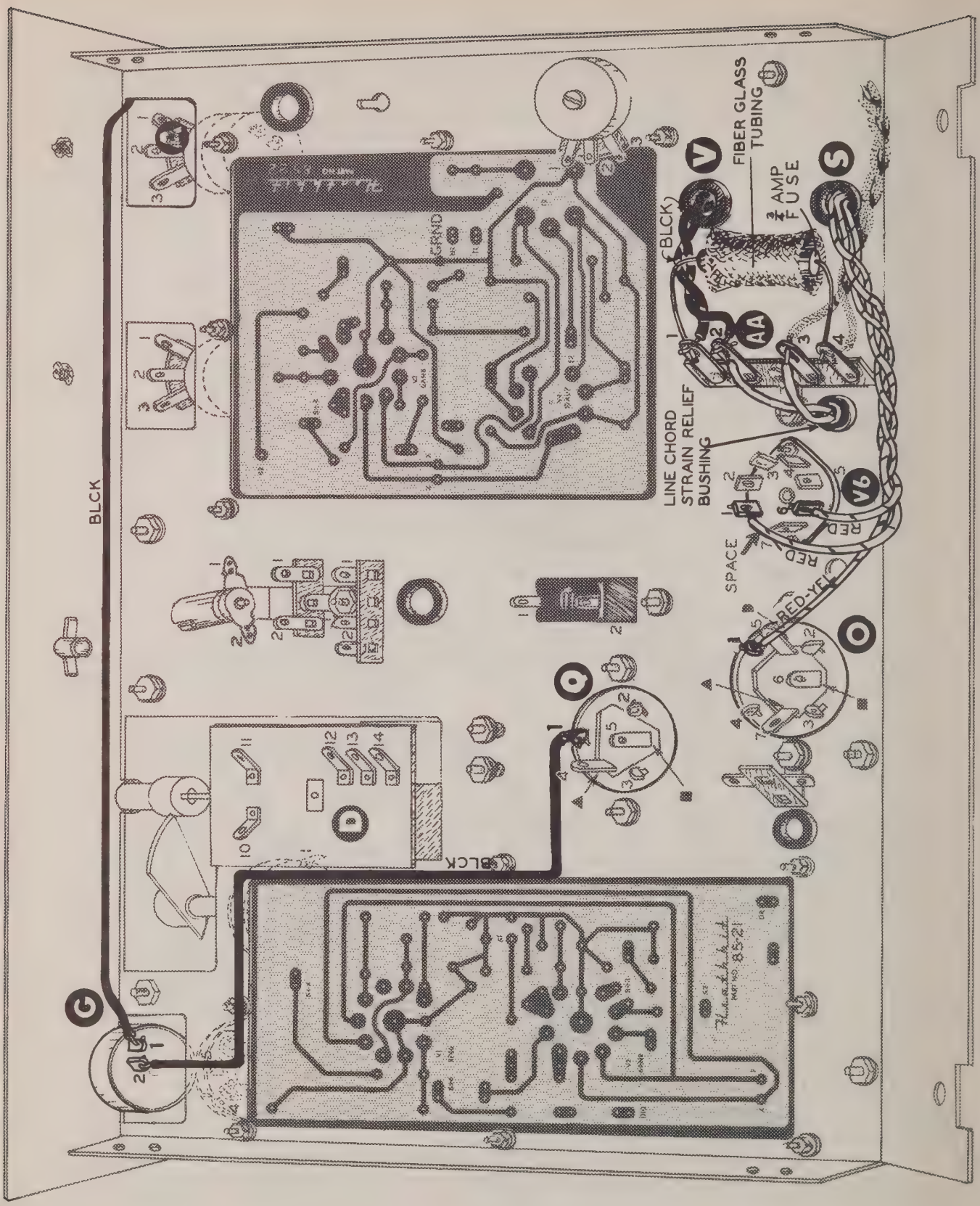


Figure 13

NOTE: In the next several steps, trim all transformer leads to just the right length to make proper connection with the indicated terminals.

( ) The two green transformer leads must be twisted together and then connect one lead to lug Y-3 (S2) on control Y.

( ) Connect the other green lead to lug Y-1 (S2) on the same control.


BLCK
GRND
(BLCK)
FIBER GLASS TUBING
3/4 AMP FUSE
LINE CHORD STRAIN RELIEF BUSHING
SPACE
RED
RED-YE
BLCK

( ) Twist the black transformer leads together and connect one to lug AA-1 (NS) on terminal strip AA.

( ) Connect the other black lead to terminal AA-2 (NS).

( ) After twisting the two red and one red-yellow transformer leads together, connect one red lead to pin V6-1 (S1) on tube V-6.

( ) Connect the other red lead to pin V6-6 (S1).

( ) Connect the red-yellow lead to lug O-1 (S1) at the base of capacitor O.

( ) Prepare a line cord and line cord strain relief bushing in such a manner that about 2" of line cord will be available on the inside of the chassis (refer to Figure 14 for the installation of the line cord strain relief bushing).

Figure 14

( ) Connect one of the leads from the line cord to lug AA-2 (S3) on terminal strip AA.
( ) Now connect the other lead of the line cord to lug AA-3 (S2) of the same terminal strip.

( ) Cut both leads of one of the fuses to a length of 1". Slip the length of fiber glass tubing over one lead so that it surrounds the body of the fuse.

( ) Connect one fuse lead to terminal strip lug AA-1 (S2) and the other lead to lug AA-4 (S3). NOTE: Dress the fuse straight out from terminal strip AA to insure against either of the leads coming into contact with the metal chassis.

( ) Place the chassis in a position so that the "Magic Eye" tube socket V5 is accessible.

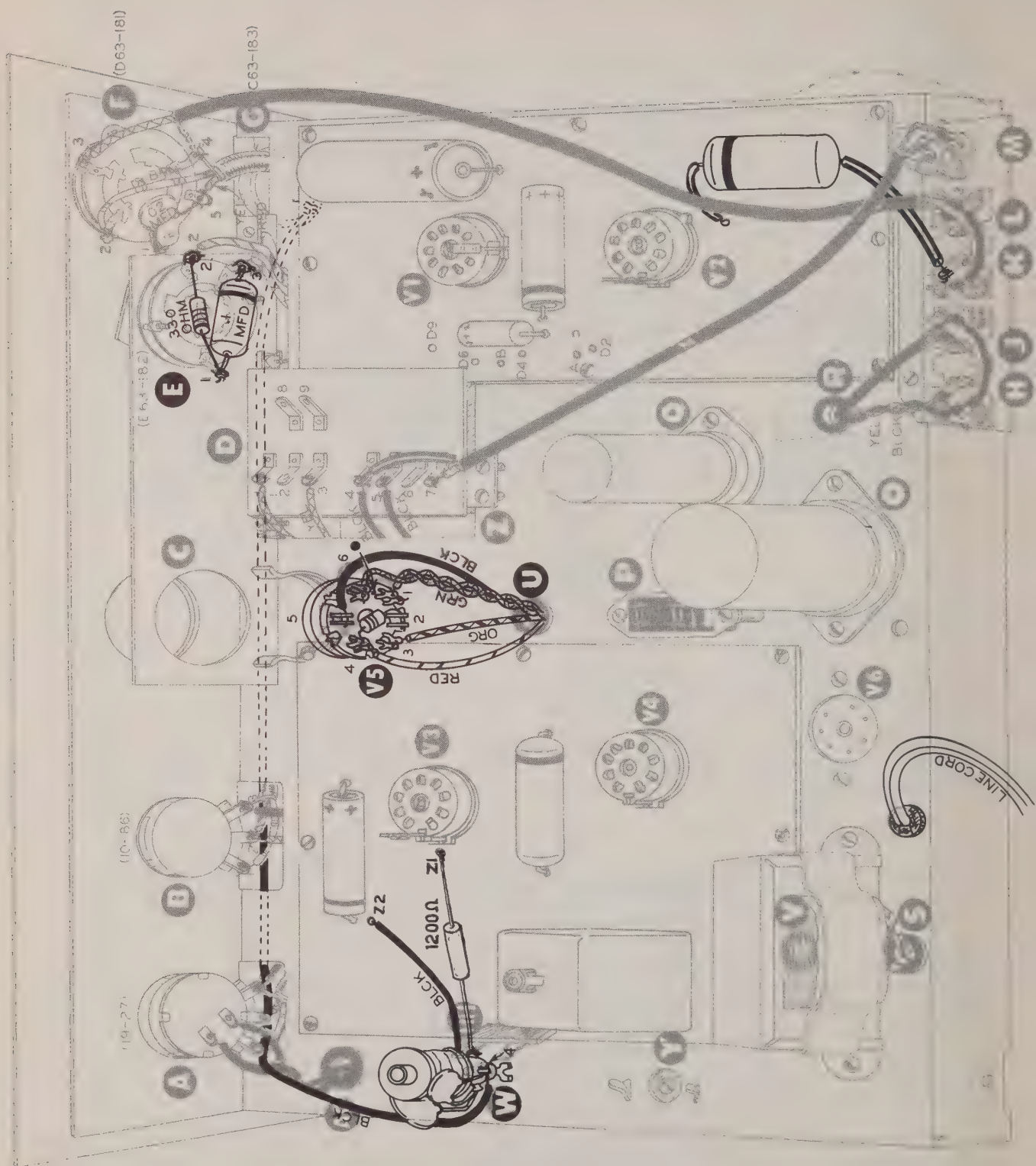
( ) Trim the leads of a 1 megohm resistor (brown-black-green) to a length of 3/8" and connect one of these leads to pin V5-2 (S1) of tube socket V5. Refer to Pictorial 12. Keep the resistor close to the socket and position as shown in Pictorial 12.

( ) The other lead must be connected to pin V5-4 (NS).
( ) Connect the red lead which extends from grommet U to pin V5-4 (S2) of the 6-pin socket V5.
( ) Connect the orange lead to pin V5-3 (S1).
( ) Connect the black wire to V5-5 (S1).

( ) Cut both leads of a 330 ohm resistor (orange-orange-brown) to 7/8" and connect one end of this resistor to lug E-2 (S2) of Function Switch E. See Pictorial 12.

( ) Connect the other lead to lug E-1 (NS).
( ) Cut both leads of a .1 mfd 400 v capacitor to 5/8" and connect one lead to terminal lug E-3 (S2) of Switch E.

( ) Connect the other lead to lug E-1 (S2).




Pictorial 12

( ) Mount the equalizer coil in the chassis hole W as shown in Pictorial 12. Notice that there are two wires extending from the equalizer coil. Position the coil so that the red wire comes closest to the circuit board.

( ) Replace the red lead extending from lug 1 of the equalizer coil W with a 1200 ohm (brown-red-red) 1/2 watt resistor (S1) and connect to point Z1 (S1) on the component side of circuit board #85-22. Position as shown in Pictorial 12 and keep the leads as short as possible.

( ) Connect the black lead which comes from the same coil to point Z2 (S1) on the component side of circuit board #85-22.

NOTE: Perform the following two steps only if you are constructing either a TR-1AH or TR-1AQ Stereo Recorder.

( ) Replace $C_7$, the .0013 mfd disc ceramic capacitor mounted on equalizer coil W, with a - {TR-1AH: .002 mfd disc ceramic / TR-1AQ: 910 mmf mica} capacitor.
This capacitor mounts on lugs 2 and 3, numbering counterclockwise from lug 1, which has the 1200 ohm resistor mounted to it. Solder W-2 (S1) but do not solder W-3 (NS) at this time.

( ) Replace $C_8$, the .0015 mfd capacitor on lugs W-3 and W-4, with a {TR-1AH: .005 mfd / TR-1AQ: .002 mfd} disc ceramic capacitor. Solder W-3 (S2) but do not solder W-4 (NS) at this time.

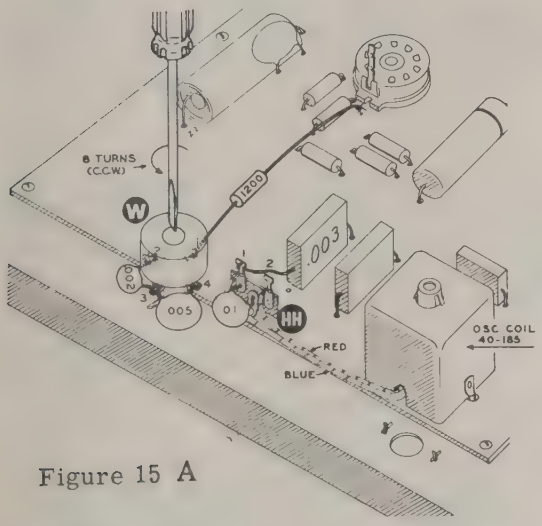


Figure 15 A

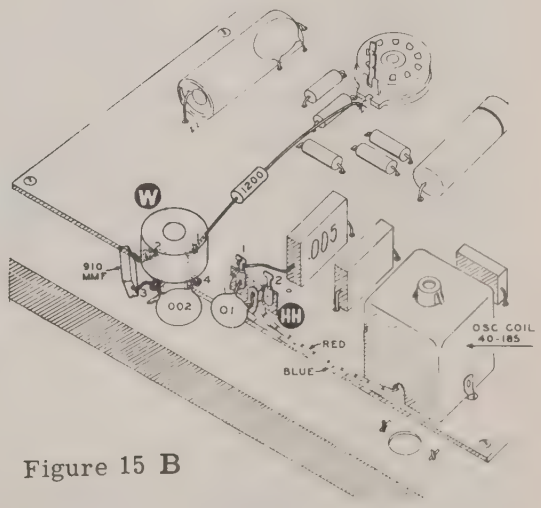


Figure 15 B

NOTE: The next two steps apply only to the TR-1AH, and are to be disregarded if you are constructing either the TR-1A or the TR-1AQ.

( ) Carefully insert a screwdriver into the top of coil W and turn the slug clockwise (with the TE-1A bottom cover removed to provide clearance for the bottom screw) until the coil slug turns no further. DO NOT TURN THE SLUG ANY FURTHER CLOCKWISE. It is necessary to retune the audio equalizer coil now, by turning the slug counterclockwise (from the top of the chassis). Since this adjustment must be made accurately, it will be necessary to make a mark with a crayon or pencil on both the screwdriver blade and the top of the coil, so that they line up initially. In this manner it will be easy to determine a complete turn. After this is done, turn the coil slug counterclockwise exactly eight (8) full turns. See Figure 15A.

( ) Turn the unit over and if the coil slug shaft extends to the bottom edge of the chassis or more, shorten it with a pair of diagonal cutters to sufficiently clear the bottom cover when it is in place. DO NOT put excessive strain upon the coil or disturb its adjustment.

( ) Prepare a black wire 13 1/2" long and connect one end to solder lug W-4 (S2) on the equalizer coil W. Run the lead along the chassis and down through the chassis cutout directly under control A; run the wire along the front panel as shown in Pictorial 11.

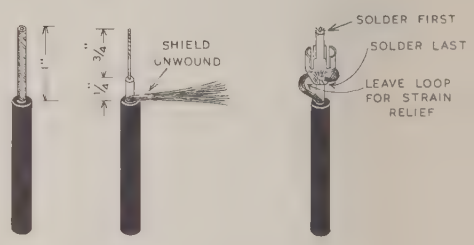
( ) Connect this wire to lug G-1 (S1) on switch G.

( ) Prepare a black wire 8" long and connect one end to lug G-2 (S1).

( ) Route the wire on the edge of the circuit board so that it may be soldered to lug Q-1 (S4) of capacitor Q. Refer to Pictorial 11.

( ) At this time, loosen all control nuts on the front dress panel. Place the knobs on the control shafts (see photo, page 1), and rotate all knobs to their maximum clockwise position. Align each pointer on the knobs to the panel marking for the maximum clockwise position. Remove the knob on the Playback Gain Control and tighten the control nut securely. Continue this procedure toward the opposite end of the panel, after being sure the push button works freely.

( ) Referring to Detail 15, prepare three shielded cables as shown. Place a phono plug on both ends of each one. One cable should be 12" in length and two should be long enough to connect your external equipment.

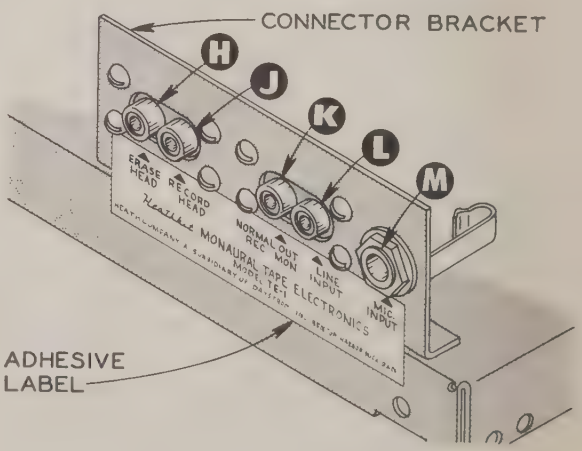



Detail 15

( ) Cut a 15" black lead and a 15" yellow lead. Strip 1/2" of insulation off both ends of each. Twist these two leads together and place a phono plug on each end of the yellow lead (solder both connections at this time). Solder the ends of the black lead to the connector shell. These cables will be used in the Installation Section of this manual.

( ) Install the 2 mfd 200 V coupling capacitor on circuit board 85-21 (S1). Connect the other lead to K1 (S1). Position exactly as shown and use sleeving on both leads.

( ) Peel off the backing of the adhesive label and install it on the connector mounting bracket as shown in Detail 16. Be sure the label is aligned properly with the jacks before pressing it firmly to the chassis.




Detail 16

The following three steps apply only to the TR-1AH and TR-1AQ.

( ) There is only one Sync Cable Assembly (#134-7) required for stereo operation. Locate this assembly, pull it apart and solder one of the cables to the junction between C23 and R28, point A on circuit board #85-22. This connection is made from the component side, as shown in Figure 16. The other portion of the cable assembly will be soldered to the comparable point A in the other TE-1A.

( ) After the second channel TE-1A is constructed, connect the sync cables together, and the TE-1A's are complete for stereo operation.

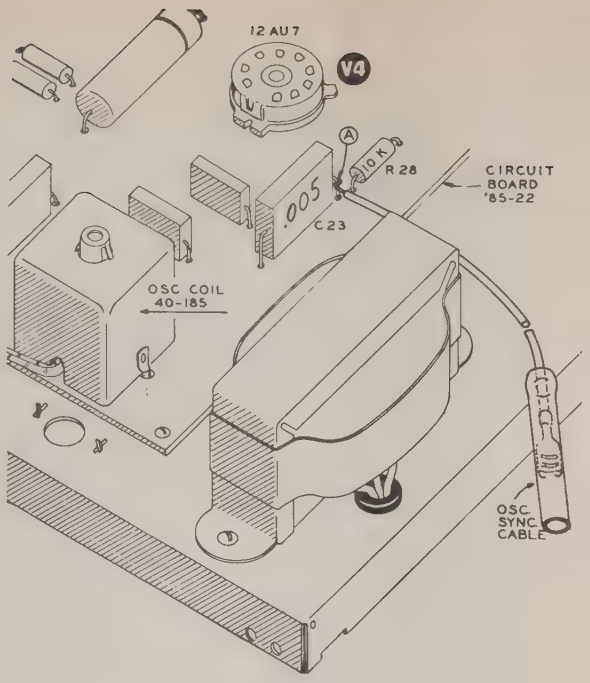



Figure 16

NOTE: Monaural recording is accomplished by simply placing the Power switch of one of the units in the OFF position.

( ) Figure 17 shows the correct electrical connections between the Stereo Tape Deck and the TE-1A electronic units.

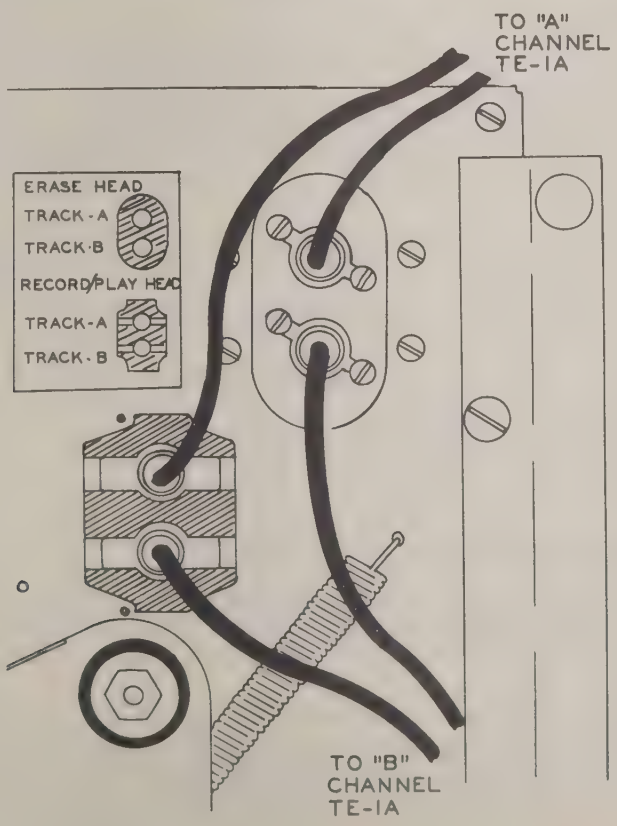



Figure 17

## PRELIMINARY TEST AND FILAMENT BALANCE ADJUSTMENT

The preliminary testing of this unit should be done with neither the record-play nor erase heads connected. If this unit is to be used with a TR-1A Series Tape Deck, the head assembly supplied with this deck has been subjected to many tests by the manufacturer and has met rigid performance specifications before being accepted by the Heath Company for shipment to you. If is for this reason that if any difficulty is experienced in recording, or playing back a tape which is known to have recorded material on it, it must be assumed that the fault is in the electronics. The heads should only be considered at fault if a thorough check of the electronics shows that the tape preamplifier is functioning normally. The head assembly is factory aligned and requires no further adjustment whatsoever. If the Heath TR-1A Series Tape Deck is used, observe the following:

CAUTION - DO NOT CHANGE THE AZIMUTH ADJUSTMENTS OF THE TR-1A TAPE DECK; THE HEATH COMPANY CANNOT GUARANTEE THE PERFORMANCE OF ANY UNIT ON WHICH THESE ADJUSTMENTS HAVE BEEN CHANGED. No connection to the tape deck should be made until the testing of the tape preamplifier has been completed.

Install the following tubes in their respective sockets:

( ) V-1 - EF86 - Preamplifier stage

( ) V-2 - 6AN8 - Playback channel

( ) V-3 - 6AN8 - Record channel

( ) V-4 - 12AU7 - Bias-erase oscillator

( ) V-5 - 6E5 - Record Level Indicator

( ) V-6 - 6X4 - Rectifier

( ) Install the #47 pilot bulb.

( ) Place shields over V-1, V-2, and V-3, making sure the spring clip is inside the tube shield.

( ) Install the knobs on the controls.

( ) Using one of the shielded cables (which was prepared in the Step-By-Step procedure), connect the Line Input Jack of the TE-1A to a high level signal source such as an audio voltage generator, tuner, TV, or tape recorder output of a preamplifier.

( ) Connect another length of shielded cable from the output jack of this unit to the input of a power amplifier, or to a high level unequalized input channel of a preamplifier-control unit.

( ) Place the Record-Play knob in the PLAY position.

( ) Place the Record Gain Control in the maximum counterclockwise position.

( ) Set the Playback Gain Control in the OFF position.

( ) Place the Input Selector Switch in the Line input position.

( ) Place the Equalization Switch in the 7.5 in./sec. position.

( ) Plug the line cord into a 105-125 volt 60 cycle AC outlet only. Turn the power switch, which is located on the Playback Gain Control, to ON. Allow the unit to warm up for approximately 15 minutes.

( ) Short the center terminal of the Record Head connector to the ground lug and advance the Playback Gain Control to the full clockwise position. There should be audible output from the power amplifier in the form of a hiss and some hum. Adjust the Filament Balance Control Y until the hum is inaudible or at a minimum. If the hum cannot be entirely eliminated

with this adjustment, reverse the line cord connection and readjust the Filament Balance Control. Whichever condition results in the lowest hum is the correct condition.

( ) Set the Playback Gain Control at approximately mid-position. Quickly remove the short from the record-play connector and then short the connector again. If the playback channel is "live", that is, functioning properly, there should be an audible indication at the output of the power amplifier due to the shorting and unshorting of the record-play head jack.

( ) Set the Playback Gain Control at minimum and the Record-Play Switch to the RECORD position. With an audio signal supplied from a preamplifier, tuner or audio signal generator, which has an amplitude of at least .25 to .5 volts, advance the Record Gain Control until there is an indication shown by the "Magic Eye" tube, with only slight overlapping.

## IN CASE OF DIFFICULTY

If, in the above steps, either the record or playback channels do not function properly, recheck the wiring against the Pictorials for an improper connection in the channel with which you are having the difficulty. If neither channel operates at all, or both appear to have the same difficulty, tube V-1 is most likely the faulty stage, as it is common to both channels. On the other hand, if one channel appears to be normal and the other channel operates improperly or not at all, this would indicate that tube V-1 and its associated components are satisfactory. This would indicate that the 6AN8 tube is the malfunctioning channel, or its associated circuits are at fault. In this manner, the troublesome circuit may be quickly isolated, and its wiring compared to the Pictorials.

First of all, carefully recheck all wiring. Compare the Circuit Boards with Figures 5 and 6 until satisfied that all resistors and capacitors are properly installed in the right places. Often, having a friend check the work will reveal a mistake consistently overlooked.

Inspect all tubes to be sure their filaments are lit. Normally, filaments exhibit a dull red glow, (if necessary, remove tube shields and observe in a darkened room.)

If possible, compare the tube socket voltages with those shown on the schematic. Reading within 20% of those shown may be considered normal. If a discrepancy is noted, check the associated circuits carefully. Any component in those circuits should be suspected until proven satisfactory.

Normal ac signal voltages, at 1000 cps, are indicated at various points on the schematic.

IMPORTANT: In order to avoid seriously magnetizing any of the heads, be sure to observe the following precautions before making any electrical tests:

NEVER apply an ohmmeter across any of the heads.

NEVER connect or disconnect the Record or Erase Head with the mechanism in the RECORD position.

NEVER touch any signal point in the record section or oscillator with a screwdriver, metal probe, or test probe, or remove any tubes while mechanism is in RECORD position, as this will produce strong transients which will magnetize the Record Head. Should it be necessary to check signal voltages in these circuits, always apply probe before operating mechanism to RECORD - take reading - then operate to PLAY before removing the probe.

## INSTALLATION

The TE-1A, Tape Recorder Electronics has been designed not only for use in the attractive cabinet accompanying the kit, but it has also been designed for panel mounting in a wood cabinet. (In this case, the cabinet and cabinet mounting brackets are not required.)

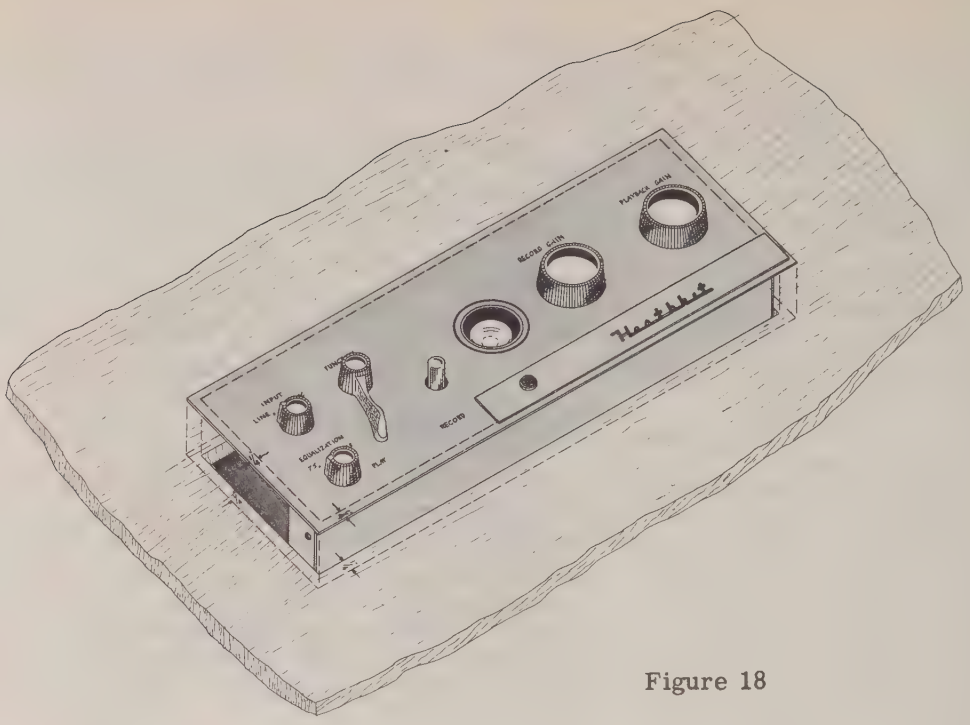


Figure 18

Figure 18 shows the required mounting board cutout. A full sized template is also provided. The minimum recommended mounting board thickness is 3/8". It may be mounted in either a vertical or horizontal position at any intermediate angle that the purchaser may desire. A cabinet of any size that will accommodate any of these angles of installation may be used.

Figure 19 illustrates the method of mounting, using the two #6-32 bolts and speednuts, the #10-24 x 2 1/4" bolt and speednut, or both hold-down methods. Either or both of these methods are recommended because then the unit is not suspended by the front panel alone. This results in the sufficient amount of rigidity required if it is desired to mount it in a portable case.

If the unit is mounted in an enclosure of minimal volume, air circulation should be provided by means of vents or louvres at both the bottom and rear of the enclosure.

( ) Find the Mounting Board Template and cut it out on the outside panel line with a pair of scissors. Lay this cutout on the mounting board in the position in which the panel will be. Use a sharp object, such as an ice pick, to make holes in the four corners into the wood mounting board. These holes will mark the cutout corners. Remove the template and draw lines connecting the four corner marks. Carefully drill holes at the four corners and cut along the four lines which form the outline of the mounting hole, with a keyhole saw.

( ) Set the TE-1A into the mounting hole which was just cut and secure it in place with either the two #6-32 x 1" bolts, the #10-24 x 2 1/4" bolt and T-nut, or both.

( ) If this unit is to have the feet and vinyl clad steel cabinet mounted, refer to Pictorial 13 on Page 52 for installing the feet, cabinet mounting brackets, and cabinet.

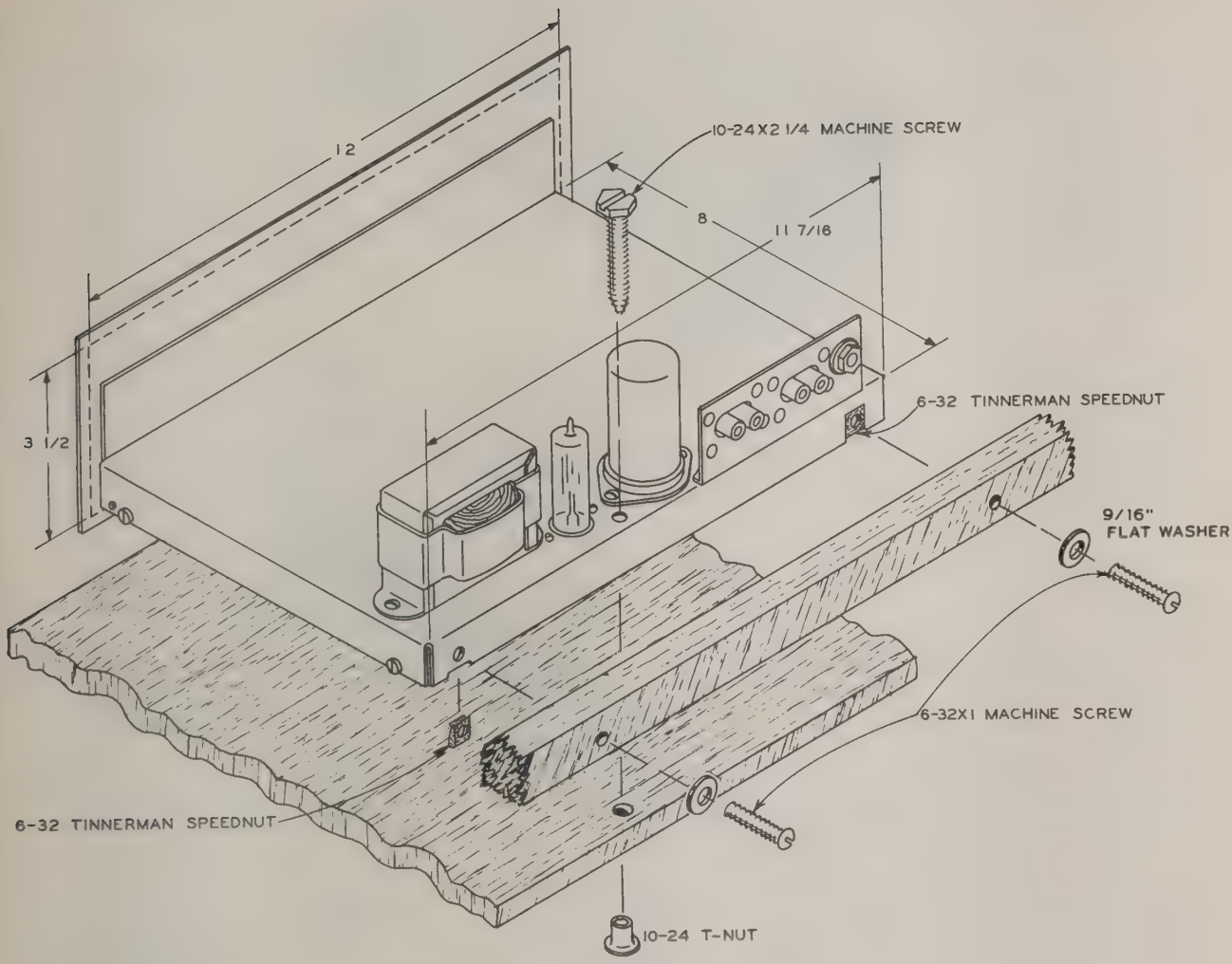
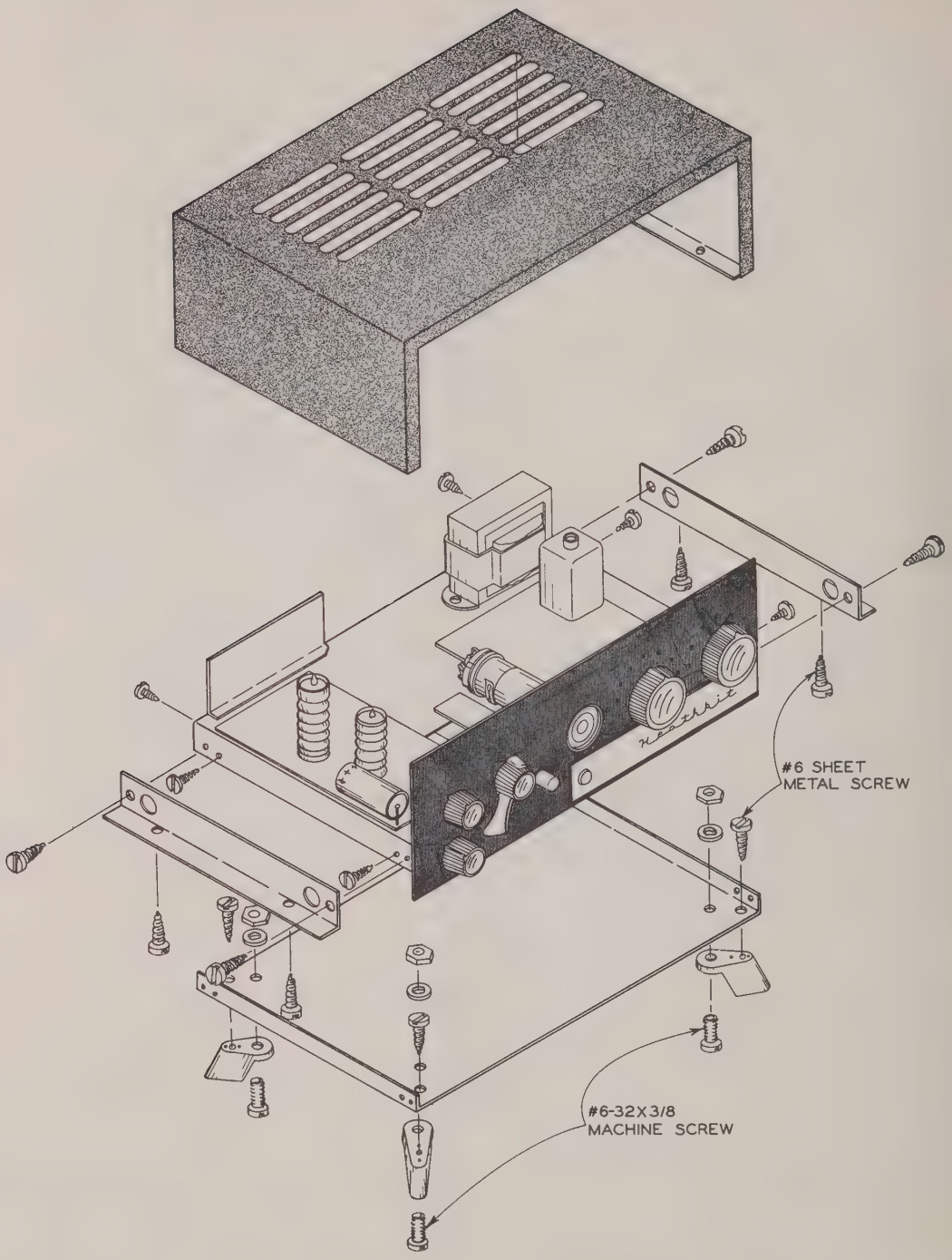

12
10-24X2 1/4 MACHINE SCREW
8
11 7/16
3 1/2
6-32 TINNERMAN SPEEDNUT
9/16"
FLAT WASHER
6-32X1 MACHINE SCREW
6-32 TINNERMAN SPEEDNUT
10-24 T-NUT

Figure 19




Pictorial 13

( ) Connect one of the shielded cables, previously prepared, from the Line Input Jack to the desired high level signal source, such as a tuner, or the Tape Recorder Output Jack of a preamplifier.

( ) Connect another of the shielded cables from the Output Jack of the TE-1A to the Input Jack of the external equipment.

( ) Connect the third shielded cable from the Record-Play Head Jack of the TE-1A to the Record-Play Head Jack located on the tape deck. Or, plug the Record-Play Head into the Record-Play Head Jack, if the head already has a shielded cable connected to it.

( ) Connect the "twisted pair", which was prepared with a phono plug on each end, from the Erase Head Jack on the connector bracket to the Erase Head Jack on the tape deck. Figures 20A and 20B on pages 54 and 55 show external arrangements, depending upon the auxiliary equipment to be used.

## OPERATION

Let us assume, to begin with, that the unit is "OFF" and all necessary connections have been made with the tape deck and associated equipment.

Place the Record Gain Control in the maximum counterclockwise position, and the Input Selector Switch in the appropriate position, depending upon the signal source. The Equalization Switch should be placed into the position corresponding to the speed at which the tape deck will be operated.

Turn both the TE-1A and the tape deck power switches to their "ON" positions and allow a warm-up period of at least two minutes.

To record, first depress the Record Interlock Button, then operate the Function Switch to the RECORD position. This, of course, places the bias-erase oscillator and "Magic Eye" circuits into operation.

Place the tape deck into the PLAY position and immediately advance the Record Gain Control so that the peak program material just causes the shadow to close. Advancing the Record Gain further would then begin to distort the recorded material during loud passages.

To play back the recorded material, simply operate the Function Switch to the PLAY position. Place the tape deck mechanism to the REWIND position and return to the start of the recording just made. When the beginning of the recording has been located, place the tape deck in the PLAY position and advance the Playback Gain Control to produce the desired output level of the external equipment.

## MAINTENANCE

There are no prescribed periodic maintenance checks for the tape preamplifier unit, except that the Filament Balance Control may have to be readjusted after the unit has been in operation for some time, if the hum level becomes objectionable.

A tape deck, owing to its mechanical nature, is generally the only portion requiring periodic maintenance. Its maintenance amounts to occasional oiling and adjustment. Most tape mechanisms have a Maintenance Manual accompanying them, with detailed instructions that should be followed very closely if satisfactory performance is expected throughout the entire life of the tape deck. Its life may be shortened considerably unless the accompanying instructions are followed to the letter.

# STEREOPHONIC SYSTEM EXAMPLE OF CONNECTIONS

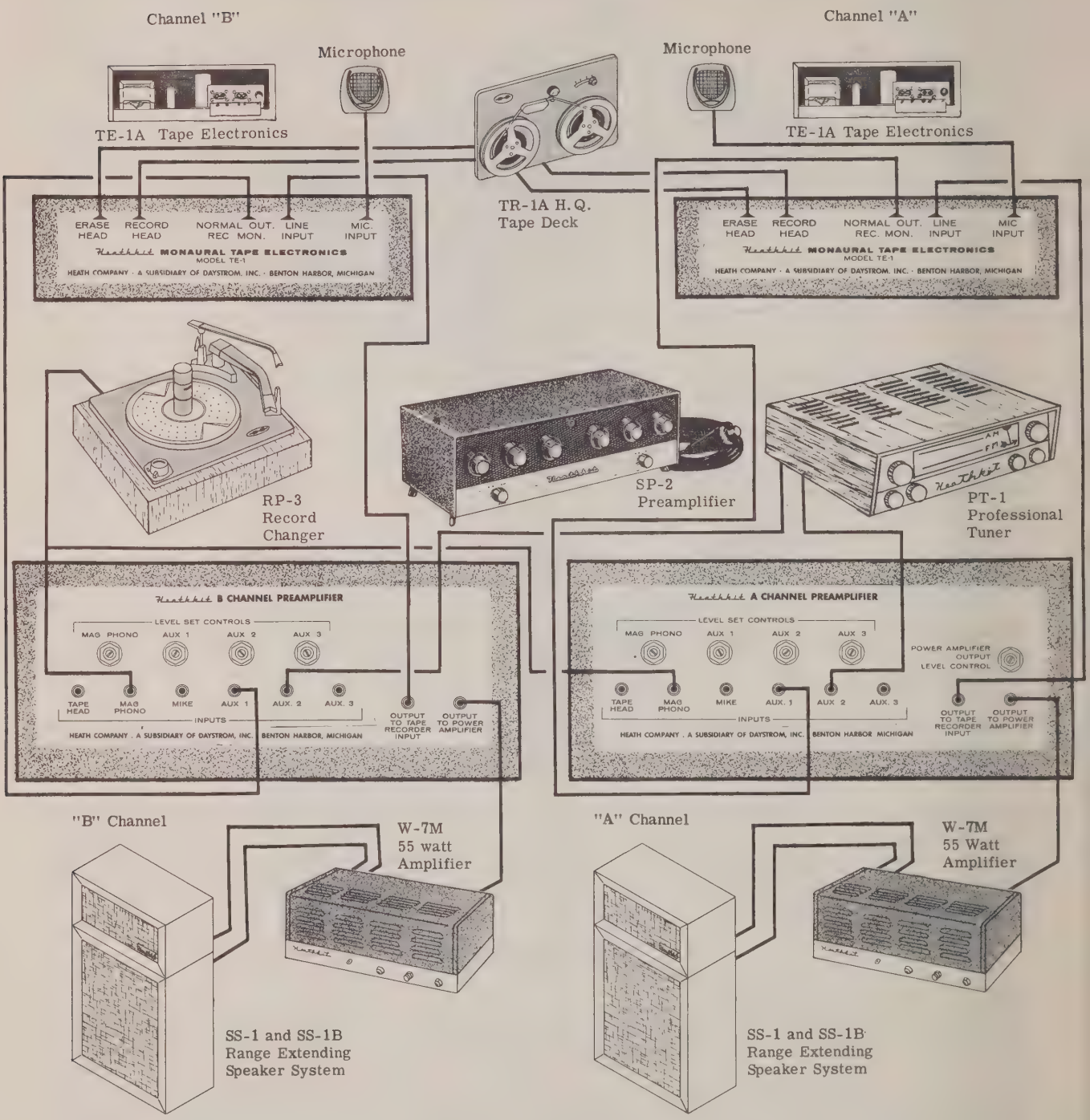



Figure 20A

# MONOPHONIC SYSTEM EXAMPLE OF CONNECTIONS

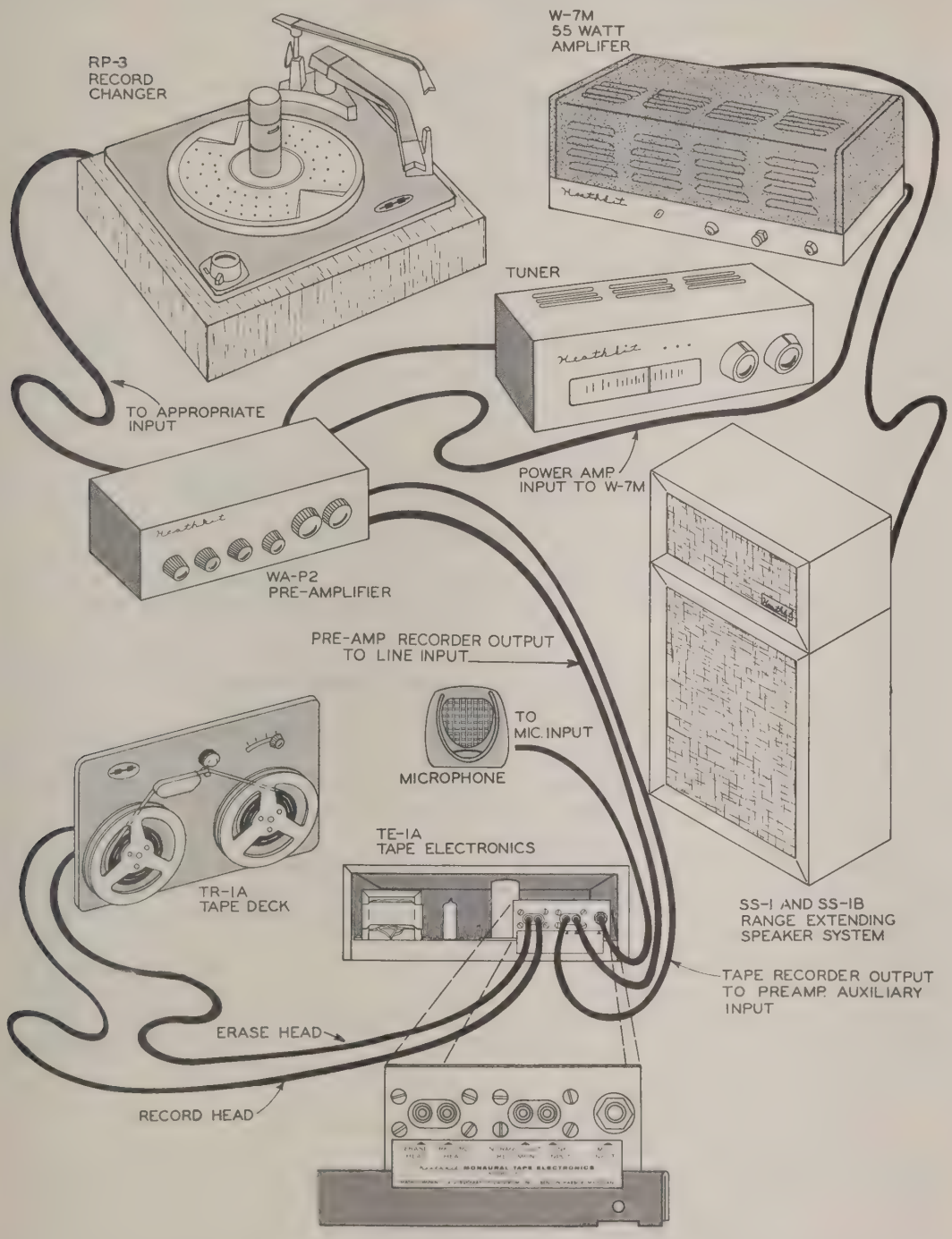



Figure 20B

However, the maintenance of the head assembly is well worth generalizing on in this manual, since the overall performance of the tape recorder is directly dependent upon the condition of the heads.

After every 50 to 100 hours of operation, the surfaces of all the heads should be inspected for oxide accumulation. Generally, the faces should be cleaned at these intervals, using alcohol and a soft cloth. This, of course, allows the heads to make better contact with the magnetic tape, which has a direct bearing on the high frequency response.

Any dc or permanent magnetization in any of the heads will result in increased background noise in recording and/or playing back.

While the TE-1A has been designed to minimize the possibility of head magnetization, some degree of magnetization, owing to program transients, is inevitable after long periods of use.

To determine if the noise level is above normal, load the tape deck with a reel of tape and operate it into the PLAY or FORWARD position. Set the Record Gain Control to minimum and operate the Function Switch of the TE-1A to the RECORD position, and the recorder is now erasing. Erase a portion of the tape (one or two minutes), operate the TE-1A to the PLAY position and go back to the beginning of the erased portion of the tape. Place the deck into the FORWARD position and turn the Playback Gain all the way up so that a hiss may be heard. If the noise level drops appreciable when the tape is stopped, it is an indication that the heads should be demagnetized.

A number of head demagnetizers are commercially available at a small cost. If one is purchased, the instructions accompanying this device should be followed, and all heads on the tape deck should be demagnetized.

The purchase of a commercial head demagnetizer is not necessary, however, if you have access to a gun-type soldering iron. First, be sure there is no recorded tape on or adjacent to the tape recorder, then energize the transformer of the soldering gun. Hold the case (not the tip) of the soldering gun close to each one of the heads, then slowly withdraw it to a distance of 3 or 4 feet before deenergizing it. This method is quite adequate for degaussing (demagnetizing) the heads, and will contribute to a lower distortion and noise level.

If a TR-1A Series Tape Deck is used, head alignment is not necessary initially, because the heads are prealigned at the factory. However, after many hours of operation, if a distinct loss of high frequency is noticeable while playing back commercially pre-recorded tapes, realignment of the Record-Play Head is necessary. This is easily accomplished by slightly loosening the locknut for the Playback Head, using an appropriate size Allen wrench. Insert the wrench into the azimuth adjustments (the setscrews) and while listening to a recording known to have many high frequencies, adjust the azimuth for the maximum amount of highs to be heard in the output. The adjustment will probably have to be "rocked" several times to be sure of the best setting, but this method is quite accurate. After this is done, retighten the locking nut.

## TE-1A COMPATIBILITY INFORMATION

### USING THE TE-1A WITH ERASE AND COMBINATION RECORD-PLAY HEADS OF VARIOUS CHARACTERISTICS

This material does not apply to the heads included with the TR-1A, TR-1AQ, TR-1AH, MK-4 or MK-5. If the TE-1A is to be used with any of these kits, ignore this material.

For your convenience the electrical specifications of the TR-1A monaural heads are listed on the following page. If the electrical requirements of your heads are the same as, or very similar to, the values listed, then no circuit adjustments are required in order to obtain satisfactory performance from your recorder. If the information you have is not complete, at

least the erase, bias, and recording (audio) currents must be known in order to adapt the TE-1A to the heads. (If you do not have this information, it may be obtained by writing directly to the manufacturer of your tape deck. Be sure to include any information about the recorder that you can determine, such as model number, serial number, date purchase, etc.)

| | RECORD-PLAY HEAD | ERASE HEAD |
|---|---|---|
| Inductance, 60 kc | | 53 mh |
| Inductance, 1 kc | .3 henry | |
| Impedance, 1 kc | 1800 ohms | |
| Impedance, 60 kc | 25,000 ohms | 22,000 ohms |
| Coil Resistance | 275 ohms | |
| Bias Current, 60 kc | 0.6 ma | |
| Record (Audio) Current | 0.06 ma | |
| Erase Current, 60 kc | | 12 to 14 ma |
| Erasure of 400 cps Saturated Signal | | 60 db |

NOTE: The TE-1 or TE-1A is not recommended for use with very low impedance, transformer coupled head types.

Playback Channel Equalization

The TE-1A requires no circuit modification to provide proper playback response to pre-recorded tapes employing NARTB equalization.

## PROCEDURE FOR ADAPTING ERASE AND RECORD CIRCUITS

NOTE: The following procedure applies to monaural, half-track stereo, and also the new quarter-track stereo erase and combination record-play heads.

Oscillator Circuit Adjustments

In the case of a stereo erase head, either half or quarter-track, each track is to be considered as a separate erase head. The two erase tracks should not be paralleled and driven by the same oscillator. This will allow the user to record and play back monaural as well as stereo. Thus, all of the connections to the erase and record-play heads for the upper track must go to one tape electronics unit, and all of the connections for the lower erase and record-play track must go to the tape preamplifier for the second channel.

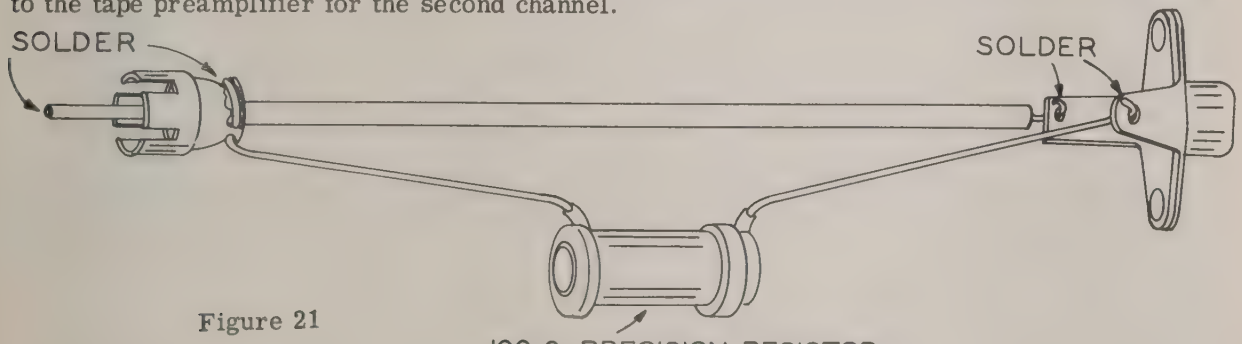



Figure 21

( ) Allow the TE-1A to warm up (without the heads connected).

( ) Cut a 3 1/2" piece of heavy red insulated wire and strip 3/8" of insulation from each end. Referring to the illustration on the preceding page, insert one end into a phono plug until it protrudes approximately 1/8" (S1). Connect the other end to the tab on the center connector of a phono jack (S1).

( ) Connect one end of the 100 ohm precision resistor to terminal 2 of the phono jack (S1). Solder the other lead of the resistor to the shell on the phono plug (S1). This is the standard test resistor for all remaining tests.

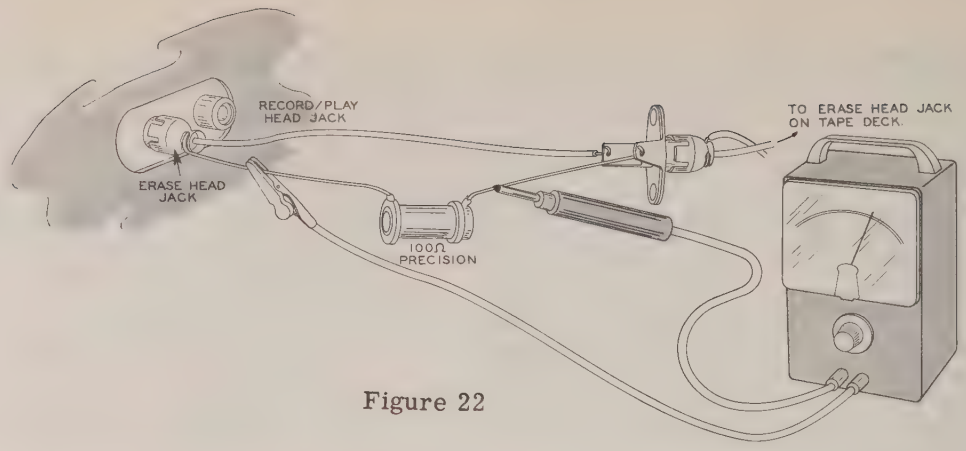



Figure 22

( ) Connect the test resistor in series with the cable coming from the erase head (or one track, if it is a stereo erase head), to the jack on the output connector bracket labeled "Erase".

NOTE: It is not practical for the Heath Company to furnish specific details and instructions concerning the ground circuits of all the decks that may be used with the TE-1A Tape Electronics unit, but the following general information should serve as a guide. If, in the next step, no reading is obtained across the resistor, then it might be assumed that a ground circuit exists between the TE-1A and the head circuit on the tape deck. The difficulty must be located and the cause removed, but it is very important that the tape deck chassis and the TE-1A chassis are grounded together. In addition, uninsulated shielded cables touching together or touching the chassis may also short out the resistor. Although this will cause no damage to the heads or the deck, this would of course make it impossible to continue. Keeping the above information in mind throughout the following procedure should assure that no difficulty of this nature will interfere with obtaining accurate measurements.

( ) Connect an audio voltmeter which has a frequency response at least to 70 kc and a .01 volt (10 millivolt) range, across the resistor. (A shielded lead is permissible in these tests only if it is a low-loss type (Belden RG-58/AU or equivalent).) Place the meter on the 10 volt range and then operate the TE-1A into the RECORD position. Reduce the range selector switch of the audio voltmeter until an accurate reading can be made. Return the TE-1A to the PLAY position. Insert the value of the indicated voltage into the formula,

$$\frac{V}{.1} = I \text{ ma.} \qquad V = \text{volts} \quad I = \text{current} \quad \text{ma} = \text{milliamperes}$$

This will yield the erase current directly in milliamperes.

( ) If the erase current is higher than the recommended value for your particular head, reduce the value of C12. Conversely, increase the value of C12 if the current is too low. C12 is the capacitor which connects between the erase jack and one of the secondary taps of the oscillator coil, and mounts on the record circuit board (#85-22) next to the oscillator coil (#40-185).

Record Circuit Adjustments

( ) After the proper amount of erase current is obtained, place the TE-1A into the PLAY position. Remove the test resistor from the erase circuit and connect it in series with the cable from the record-play head. Place the voltmeter leads across the test resistor. Turn the Record Gain control full counterclockwise (minimum setting).

( ) Connect the erase head cable to the erase jack of the TE-1A. (Failure to do this will result in erroneous bias current setting.)

( ) Place the TE-1A into the RECORD position and reduce the VTVM range until an accurate voltage reading is indicated (one-half scale of deflection or more). Leave the TE-1A in the RECORD position only long enough to accurately determine the voltage across the resistor, then place the TE-1A into the PLAY position.

( ) Substitute the voltage reading (V) into the formula $\frac{V}{.1} = 1$ ma.

(For example, if V = .1, then $\frac{.1}{.1} = 1$ ma, or one milliampere of current.)

( ) If the current is too high, increase the value of R27 (Pictorial 10, Page 40, the 82 K ohm resistor connected between terminals 1 and 2 on terminal strip CC) until the manufacturer's recommended value is obtained. (For most half-track heads the bias current is between .8 and 1.2 ma. The new quarter-track heads generally require 0.30 to .40 ma.) Most quarter-track heads will require 150 K ohm to 180 K ohm. Return the TE-1A to the PLAY position.

( ) Connect an audio generator to the LINE INPUT jack of the TE-1A and set it for .25 volts at 1,000 cycles. Remove the oscillator tube, V5, from its socket and place the TE-1A into the RECORD position. Advance the setting of the Record Gain control until the shadow of the Record Indicator eye tube just closes. Reduce the setting of the voltmeter range switch until a reading can be determined. This reading will be on the order of .002 to .006 volts (2 to 6 millivolts). METER IS TO BE CONNECTED THE SAME AS OUTLINED IN THE PRECEDING MEASUREMENT.

( ) Again, insert the voltage reading into the formula $\frac{V}{.1} = I$ ma.

This is the record current, and should be from .02 to .06 ma. If the value exceeds the manufacturer's stated value for recording current, increase R16, the 47 K ohm resistor installed in Step 5, Page 16. If it is low, decrease the resistance of R16. (R16 should <u>never</u> be less than 10 K ohm.)

( ) Remove the test resistor from the circuit.
( ) Resolder any ground connections which were removed during this procedure.

( ) This completes the circuit adjustments required to adapt a TE-1A to most head types for recording purposes. If two TE-1 kits are being used for stereo, be sure to make these same changes in the second unit. It is not necessary to make the measurements for the second TE-1A, since the values just determined are valid for both channels.

For stereo it is necessary to synchronize the bias-erase oscillators of the two tape electronic units. If you are using the two TE-1 (or TE-1A) kits for your stereo recorder, refer to the illustration on the following page and connect a length of hookup wire from point A in one TE-1 (TE-1A) to the comparable point A on the other TE-1 (TE-1A).

If only one TE-1A and a tape recorder other than the TE-1A are to be used together, connect a .1 μfd capacitor to point A on the TE-1A record circuit board (use sleeving), splice a length of hookup wire to the other capacitor lead (solder and cover with sleeving), and connect this lead to the control grid or cathode of the other oscillator circuit.

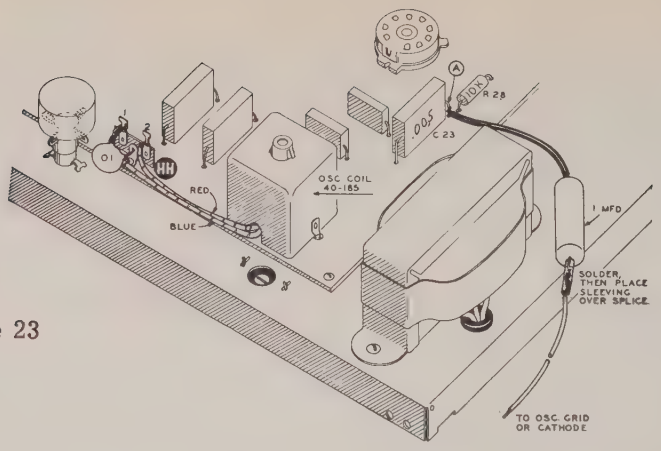



Figure 23

To record monaurally, when using either half or quarter-track heads, it is only necessary to place the power switch of one of the electronic units into the OFF position. This will in no way affect the recording capabilities of the other channel.

## SERVICE

If, after applying the information contained in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under "IN CASE OF DIFFICULTY." Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under "IN CASE OF DIFFICULTY." Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit model number and date of purchase, if available.

5. Print or type your name and address, preferably in two places on the letter.

With the above information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. He will make no incorrect assumptions nor waste time checking files for the correct spelling of name and address. (The automatic letter opener sometimes cuts through the letter, hence the suggestion to print the name and address twice.) In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with suf-

ficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed instrument (including all connecting cables) to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a fixed fee of $6.00, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although you may find charges for local service somewhat higher than those listed in HEATHKIT manuals (for factory service), the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

## REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

## SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

ATTACH A TAG TO THE EQUIPMENT BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan

Include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

## WARRANTY

Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

In the event that one of the circuit boards for your TE-1A has been ruined through accidental use of acid or paste fluxes, or for any other reason, a convenient repair kit is available for each of the two boards. The kit consists of a new circuit board, new tube sockets, and all board mounted resistors and capacitors. The kit does not include any large electrolytic capacitors or the oscillator coil. These items must be removed from the damaged board.

The repair kits may be ordered from the following information:

| | | |
|---|---|---|
| Kit #R-TE-1A-RO | Repair Kit | Record Oscillator Circuit Board |
| Kit #R-TE-1A-PB | Repair Kit | Playback Circuit Board |

## PARTS LIST

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **Resistors** | | |
| 1-4 | 1 | 330 ohm 1/2 watt (orange-orange-brown) |
| 1-9 | 5 | 1 K ohm 1/2 watt (brown-black-red) |
| 1-10 | 1 | 1200 ohm 1/2 watt (brown-red-red) |
| 1-20 | 5 | 10 K ohm 1/2 watt (brown-black-orange) |
| 1-22 | 1 | 22 K ohm 1/2 watt (red-red-orange) |
| 1-23 | 1 | 27 K ohm 1/2 watt (red-violet-orange) |
| 1-24 | 1 | 33 K ohm 1/2 watt (orange-orange-orange) |
| 1-25 | 2 | 47 K ohm 1/2 watt (yellow-violet-orange) |
| 1-26 | 5 | 100 K ohm 1/2 watt (brown-black-yellow) |
| 1-31 | 1 | 330 K ohm 1/2 watt (orange-orange-yellow) |
| 1-35 | 9 | 1 megohm 1/2 watt (brown-black-green) |
| 1-60 | 1 | 68 K ohm 1/2 watt (blue-gray-orange) |
| 1-102 | 1 | 82 K ohm 1/2 watt (gray-red-orange) |
| 1-24A | 1 | 4.7 K ohm 1 watt (yellow-violet-red) |
| 1-15B | 1 | 1 K ohm 2 watt (brown-black-red) |
| 2-54 | 1 | 200 K ohm 1/2 watt precision |
| 2-68 | 1 | 3 K ohm 1/2 watt precision |
| **Capacitors** | | |
| 20-56 | 2 | 150 mmf mica (brown-green-brown) |
| 20-73 | 1 | .003 mfd 5% mica (orange-black-red) |
| 20-75 | 3 | .005 mfd 5% mica (green-black-red) |
| 20-94 | 2 | .001 mmf 5% mica (brown-black-red) |
| 21-22 | 1 | 220 mmf ±10% ceramic disc |
| 21-31 | 7 | .02 mfd GMV ceramic disc |
| 21-36 | 1 | .002 mfd ±20% ceramic disc |
| 21-47 | 2 | .01 mfd 50 V ±10% ceramic disc |
| 23-17 | 1 | 2 mfd 200 V metalite |
| 23-44 | 1 | .033 mfd 600 V plastic molded |
| 23-53 | 2 | .1 mfd 400 V plastic molded |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **Capacitors (cont'd.)** | | |
| 23-74 | 1 | .04 mfd 400 V plastic molded |
| 25-39 | 2 | 2 mfd 150 V electrolytic |
| 25-55 | 2 | 50 mfd 10 V electrolytic |
| 25-71 | 1 | 30 mfd 200 V electrolytic |
| 25-76 | 1 | 20-20-40 mfd 400-400-350 V electrolytic |
| 25-77 | 1 | 40-20 mfd 300-300 V electrolytic |
| **Controls-Switches** | | |
| 10-52 | 1 | 2 K ohm linear control, tab mtg. |
| 10-86 | 1 | 1 megohm control, audio |
| 19-27 | 1 | 1 megohm control, audio with AC snap switch |
| 63-181 | 1 | 2 position rotary switch |
| 63-182 | 1 | 2 position rotary switch |
| 63-183 | 1 | 2 position rotary switch |
| 64-5 | 1 | Single push button switch, spring return |
| **Tubes** | | |
| 411-25 | 1 | 12AU7 tube |
| 411-64 | 1 | 6X4 tube |
| 411-68 | 2 | 6AN8 tube |
| 411-106 | 1 | EF86 tube |
| 411-120 | 1 | 6E5 tube |
| **Bulbs-Diodes-Fuses** | | |
| 412-1 | 1 | #47 pilot light |
| 56-4 | 1 | Crystal diode |
| A421-17 | 2 | 3/4 ampere fuse (1 spare) |
| **Transformers-Coils** | | |
| 40-148 | 1 | Equalizer coil |
| 40-185 | 1 | Oscillator coil |
| 54-75 | 1 | Power transformer |
| **Sockets-Terminal Strips-Circuit Boards** | | |
| 431-1 | 1 | Dual 1-lug terminal strip |
| 431-2 | 1 | 2-lug terminal strip |
| 431-3 | 1 | 3-lug terminal strip |
| 431-5 | 1 | 4-lug terminal strip |
| 431-36 | 1 | 2-lug terminal strip, miniature |
| 434-12 | 1 | 6 pin tube socket |
| 434-15 | 1 | 7 pin tube socket (wafer) |
| 434-20 | 1 | 117 V power socket |
| 434-44 | 1 | Pilot light socket, bayonet type |
| 434-78 | 3 | 9 pin molded tube socket (circuit board) w/shield |
| 434-79 | 1 | 9 pin molded tube socket (circuit board) |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| Sockets-Terminal Strips-Circuit Boards (cont'd.) | | |
| 434-82 | 2 | Double phono jack |
| 436-1 | 1 | Phone jack |
| 438-4 | 8 | Phono plug |
| 85-M21-F239 | 1 | Playback circuit board |
| 85-M22-F238 | 1 | Record circuit board |
| Hardware | | |
| 73-1 | 5 | 3/8" rubber grommet |
| 250-2 | 17 | 3-48 x 5/16" RHMS |
| 250-8 | 16 | #6 sheet metal screw |
| 250-9 | 28 | 6-32 x 3/8" RHMS |
| 250-13 | 2 | 6-32 x 1" RHMS |
| 250-16 | 1 | 8-32 x 3/16" setscrew |
| 250-29 | 2 | 6-32 x 3/4" RHMS |
| 250-48 | 1 | 6-32 x 1/2" RHMS |
| 250-123 | 1 | 10-24 x 2 1/4" slotted hex head bolt |
| 252-1 | 17 | 3-48 x 7/32" hex nut |
| 252-2 | 2 | 4-40 x 1/4" hex nut |
| 252-3 | 30 | 6-32 x 1/4" hex nut |
| 252-7 | 6 | 3/8" - 32 control nut |
| 252-17 | 1 | 10-24 T-nut |
| 252-22 | 2 | 6-32 Tinnerman speed nut |
| 253-10 | 6 | Flat control washer |
| 253-21 | 2 | Flat washer 9/16" |
| 254-1 | 30 | #6 lockwasher |
| 254-4 | 6 | 3/8" control lockwasher |
| 254-7 | 15 | #3 lockwasher |
| 254-9 | 2 | #4 lockwasher |
| 255-3 | 2 | #6 x 3/8" spacer |
| 255-1 | 2 | #6 x 1/8" spacer |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| Cabinet-Chassis-Associated Parts | | |
| 100-M192 | 1 | Record switch interlock arm assembly |
| 90-M76 | 1 | Cabinet shell |
| 200-M191 | 1 | Chassis, aluminum |
| 203-M163 | 1 | Front panel |
| 204-M206 | 1 | Switch mounting bracket |
| 204-M210 | 1 | Connector bracket |
| 204-M211 | 2 | Cabinet mounting bracket |
| 204-M214 | 1 | Shield bracket |
| 205-M122 | 1 | Bottom cover, aluminum |
| 205-M131 | 1 | Front panel trim strip |
| Miscellaneous | | |
| 75-20 | 2 | Double phono jack insulator |
| 75-24 | 1 | Line cord strain relief bushing |
| 89-1 | 1 | Line cord |
| 206-6 | 3 | 1/8" ID spirashield 12" long |
| 206-68 | 3 | 9-pin miniature tube shield |
| 208-2 | 1 | Spring clip |
| 261-11 | 4 | Plastic feet |
| 343-3 | 1 | Length shielded wire |
| 344-1 | 7 | Length hookup wire |
| 346-1 | 1 | Length insulated sleeving |
| 346-6 | 1 | Length fiber glass tubing |
| 346-7 | 3 | #5 clear plastic sleeving |
| 390-54 | 1 | Adhesive label |
| 390-6 | 1 | "Heathkit" nameplate |
| 413-5 | 1 | Pilot light jewel |
| 462-50 | 1 | Lever knob |
| 462-65 | 1 | Interlock knob |
| 462-68 | 2 | Knob, large |
| 462-69 | 2 | Knob, small |
| 481-3 | 1 | 4-prong electrolytic mounting wafer, large |
| 481-4 | 1 | 3-prong mounting wafer |
| 595-286 | 1 | Manual |

SPECIAL NOTICE #1

The parts for use with the information in the COMPATIBILITY section (see Page 56) are listed below. This information applies ONLY when heads other than those supplied with Heathkits are used.

| | | |
|---|---|---|
| 2-4 | 1 | 100 ohm 1/2 watt precision resistor |
| 341-2 | 1 | Length test lead, red |
| 434-42 | 1 | Phono connector socket |
| 438-4 | 1 | Phono plug |

SPECIAL NOTICE #2

All additional required parts are in a sub-pack included with the Tape Deck, and appear below under the model number which pertains to your recorder.

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| Model TR-1A Monophonic Tape Recorder | | |
| 240-50 | 1 | Head array |
| 390-57 | 1 | Record-play and erase head label |
| 438-3 | 1 | Phone plug |
| 480-6 | 1 | Crystal microphone |
| Model TR-1AH Half-track Mono-Stereo Tape Recorder | | |
| 1-50 | 1 | 68 K ohm 1/2 watt (blue-gray-orange) resistor |
| B21-36 | 2 | .002 mfd disc ceramic capacitor |
| 21-46 | 2 | .005 mfd ±10% 50 V disc ceramic capacitor |
| 134-7 | 1 | Cable assembly |
| 205-M163 | 1 | Phono socket mounting bracket |
| 250-2 | 8 | 3-48 x 1/4" BH machine screw |
| 252-1 | 8 | 3-48 x 7/32" hex nut |
| 254-7 | 8 | #3 lockwasher |
| 390-74 | 1 | Adhesive label, stereo terminal indication |
| 425-14 | 1 | Stereo head array, half-track |
| 434-42 | 2 | Phono socket |
| 438-3 | 2 | Phone jack |
| 480-6 | 2 | Crystal microphone |
| Model TR-1AQ Quarter-track Mono-Stereo Tape Recorder | | |
| 1-126 | 2 | 180 K ohm 1/2 watt (brown-gray-yellow) resistor |
| 20-35 | 2 | 910 mmf 5% mica (white-brown-brown-green) capacitor |
| 20-75 | 1 | .005 mfd 5% mica (green-black-red-green) capacitor |
| 21-36 | 2 | .002 mfd disc ceramic capacitor |
| 134-7 | 1 | Cable assembly |
| 250-2 | 8 | 3-48 x 1/4" BH machine screw |
| 252-1 | 8 | 3-48 x 7/32" hex nut |
| 254-7 | 8 | #3 lockwasher |
| 390-74 | 1 | Adhesive label, stereo terminal indication |
| 425-17 | 1 | Stereo head array, quarter-track |
| 434-42 | 2 | Single phono jack |
| 438-3 | 2 | Phone plug |
| 480-6 | 2 | Crystal microphone |

Model MK-4: TR-1A to TR-1AH Stereo Conversion Kit - See MK-4 Manual
Model MK-5: TR-1A to TR-1AQ Stereo Conversion Kit - See MK-5 Manual

30 MFD.
200 W.V.D.C.
FOR 85°C
.04-400

# HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

## RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

## ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

## WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

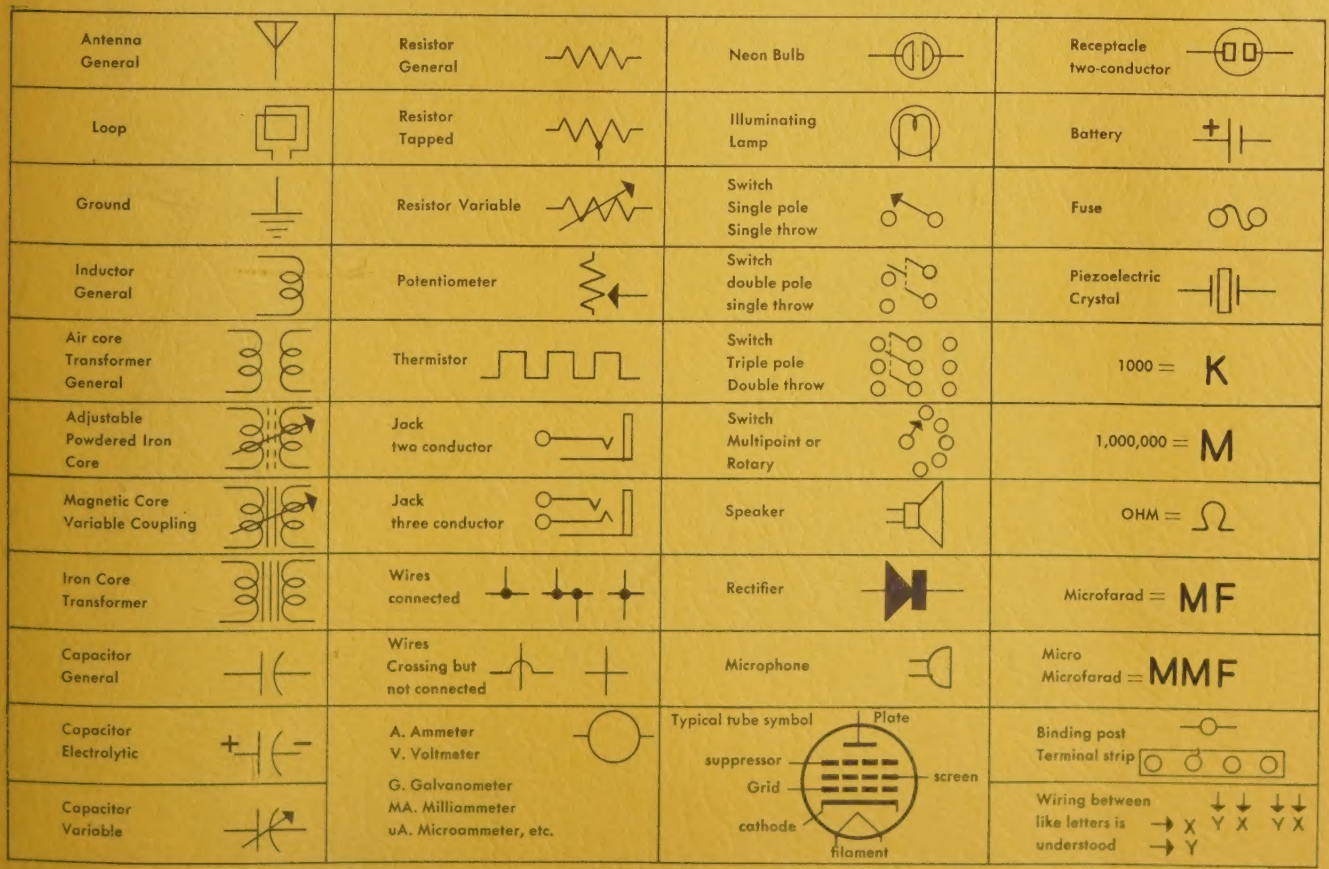
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

## SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.




Courtesy of I. R. E.

**HEATH COMPANY**

*THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM*

**BENTON HARBOR, MICHIGAN**

MP MASTER
MA24152